PHILIPS

Data handbook

PHILIPS

Electronic
components
and materials

Semiconductors and integrated circuits

Part 1 September 1971

Signal diodes

Variable capacitance diodes

Voltage regulator diodes

Rectifier diodes

Thyristors, diacs, triacs

Rectifier stacks

Accessories

Heatsinks

SEMICONDUCTORS AND INTEGRATED CIRCUITS

Part 1 **September 1971**

General

Signal diodes

Variable capacitance diodes

Voltage regulator diodes

Rectifier diodes

Thyristors, diacs, triacs

Rectifier stacks

Accessories

Heatsinks

DATA HANDBOOK SYSTEM

To provide you with a comprehensive source of information on electronic components, subassemblies and materials, our Data Handbook System is made up of three series of handbooks, each comprising several parts.
The three series, identified by the colours noted, are:

ELECTRON TUBES (9 parts)	BLUE
SEMICONDUCTORS AND INTEGRATED CIRCUITS (5 parts)	RED
COMPONENTS AND MATERIALS (7 parts)	GREEN

The several parts contain all pertinent data available at the time of publication, and each is revised and reissued annually; the contents of each series are summarized on the following pages.
We have made every effort to ensure that each series is as accurate, comprehensive and up-to-date as possible, and we hope you will find it to be a valuable source of reference. Where ratings or specifications quoted differ from those published in the preceding edition they will be pointed out by arrows. You will understand that we can not guarantee that all products listed in any one edition of the handbook will remain available, or that their specifications will not be changed, before the next edition is published. If you need confirmation that the pusblished data about any of our products are the latest available, may we ask that you contact our representative. He is at your service and will be glad to answer your inquiries.

May 1971

ELECTRON TUBES (BLUE SERIES)

This series consists of the following parts, issued on the dates indicated.

Part 1 **January 1971**

Transmitting tubes (Tetrodes, Pentodes)
Associated accessories

Part 2 **March 1971**

Tubes for microwave equipment

Part 3 **March 1970**

Special Quality tubes
Miscellaneous devices

Part 4 **April 1971**

Receiving tubes

Part 5 **May 1971**

Cathode-ray tubes
Photo tubes
Camera tubes
Photoconductive devices
Associated accessories

Part 6 **June 1971**

Photomultipliers tubes
Channel electron multipliers
Scintillators
Photoscintillators
Radiation counter tubes
Semiconductor radiation detectors
Neutron generator tubes
Photo diodes
Associated accessories

Part 7 **July 1971**

Voltage stabilizing and reference tubes
Counter, selector, and indicator tubes
Trigger tubes
Switching diodes
Thyratrons
Ignitrons
Industrial rectifying tubes
High-voltage rectifying tubes

Part 8 **August 1971**

T.V. Picture tubes

Part 9 **January 1971**

Transmitting tubes (Triodes)
Tubes for R.F. heating (Triodes)
Associated accessories

August 1971

SEMICONDUCTORS AND INTEGRATED CIRCUITS (RED SERIES

This series consists of the following parts, issued on the dates indicated.

Part 1 Diodes and Thyristors

September 1971

General
Signal diodes
Variable capacitance diodes
Voltage regulator diodes
Rectifier diodes
Thyristors, diacs, triacs
Rectifier stacks
Accessories
Heatsinks

Part 2 Low frequency; Deflection

October 1970

General
Low frequency transistors (low power)
Low frequency power transistors
Deflection transistors
Accessories

Part 3 High frequency; Switching

November 1970

General
High frequency transistors
Switching transistors
Accessories

Part 4 Special types

December 1970

General
Transmitting transistors
Microwave devices
Field effect transistors
Dual transistors
Microminiature devices for thick- and thin-film circuits
Beam lead devices for thick- and thin-film circuits
Photo devices
Accessories

Part 5 Integrated Circuits

March 1971

General
Digital integrated circuits
  DTL (FC family)
  TTL (FJ family)
  MOS (FD family)
Linear integrated circuits

COMPONENTS AND MATERIALS (GREEN SERIES)

This series consists of the following parts, issued on the dates indicated.

Part 1 Circuit Blocks, Input/Output Devices, Electro-mechanical Components *), Peripheral Devices

October 1971

Circuit blocks 40-Series
Counter modules 50-Series
Norbits 60-Series, 61-Series
Circuit blocks 90-Series
Input/output devices
Electro-mechanical components *)
Peripheral devices

Part 2 Resistors, Capacitors

December 1970

Fixed resistors
Variable resistors
Non-linear resistors
Ceramic capacitors
Polyester, polycarbonate, polystyrene, paper capacitors
Electrolytic capacitors
Variable capacitors

Part 3 Radio, Audio, Television

February 1971

FM tuners
Coils * *)
Piezoelectric ceramic resonators and filters
Loudspeakers
Audio and mains transformers
Television tuners
Components for black and white television
Components for colour television
Deflection assemblies for camera tubes

Part 4 Magnetic Materials, Piezoelectric Ceramics

April 1971

Ferrites for radio, audio and television
Small coils, assemblies and assembling parts
Ferroxcube potcores and square cores
Ferroxcube transformer cores
Piezoxide
Permanent magnet materials

Part 5 Memory Products, Magnetic Heads, Quartz Crystals, Microwave Devices, Variable Transformers

June 1971

Ferrite memory cores
Matrix planes, matrix stacks
Complete memories
Magnetic heads
Quartz crystal units, crystal filters
Isolators, circulators
Variable mains transformers

Part 6 Electric Motors and Accessories, Timing and Control Devices

August 1971

Stepper motors
Small synchronous motors
Asynchronous motors
Small d.c. motors
Tachogenerators and servomotors
Indicators for built-in test equipment

Part 7 Circuit Blocks

September 1971

Circuit blocks 100kHz Series
Circuit blocks 1-Series
Circuit blocks 10-Series
Circuit blocks for ferrite core memory drive

*) From October 1971 published in Part 1 instead of Part 5.
* *) Also included (under "Small coils, etc.") in Part 4.

September 1971

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General

Type designation
Colour codes
Rating systems
Letter symbols

PRO ELECTRON TYPE DESIGNATION CODE

FOR SEMICONDUCTOR DEVICES

This type designation code applies to discrete devices and to multiple devices [1])

The type designation consists of:

TWO LETTERS FOLLOWED BY A SERIAL NUMBER

The first letter gives an indication of the material

A	Material with a band gap of 0.6 to 1.0 eV, such as germanium
B	Material with a band gap of 1.0 to 1.3 eV, such as silicon
C	Material with a band gap of 1.3 eV and more, such as gallium arsenide
D	Material with a band gap of less than 0.6 eV, such as indium antimonide
R	Compound material as employed in Hall generators and photoconductive cells

---

[1]) A multiple device is defined as a combination of similar or dissimilar active devices, contained in a common encapsulation that cannot be dismantled, and of which all electrodes of the individual devices are accessible from the outside.

Multiples of similar devices as well as multiples consisting of a main device and an auxiliary device are designated according to the code for discrete devices described above.
Multiples of dissimilar devices of other nature are designated by the second letter G.

The second letter indicates primarily the main application respectively main application and construction if a further differentiation is essential

A	Detection diode, switching diode, mixer diode
B	Variable capacitance diode
C	Transistor for a.f. applications ($R_{th\ j\text{-}mb} > 15\ ^{o}C/W$)
D	Power transistor for a.f. applications ($R_{th\ j\text{-}mb} \leq 15\ ^{o}C/W$)
E	Tunnel diode
F	Transistor for h.f. applications ($R_{th\ j\text{-}mb} > 15\ ^{o}C/W$)
G	Multiple of dissimilar devices (see note on page 1); Miscellaneous
H	Magnetic sensitive diode; Field probe
K	Hall generator in an open magnetic circuit, e.g. magnetogram or signal probe
L	Power transistor for h.f. applications ($R_{th\ j\text{-}mb} \leq 15\ ^{o}C/W$)
M	Hall generator in a closed electrically energised magnetic circuit, e.g. Hall modulator or multiplier
P	Radiation sensitive device 1)
Q	Radiation generating device
R	Electrically triggered controlling and switching device having a breakdown characteristic ($R_{th\ j\text{-}mb} > 15\ ^{o}C/W$)
S	Transistor for switching applications ($R_{th\ j\text{-}mb} > 15\ ^{o}C/W$)
T	Electrically, or by means of light, triggered controlling and switching power device having a breakdown characteristic ($R_{th\ j\text{-}mb} \leq 15\ ^{o}C/W$) 1)
U	Power transistor for switching applications ($R_{th\ j\text{-}mb} \leq 15\ ^{o}C/W$)
X	Multiplier diode, e.g. varactor, step recovery diode
Y	Rectifying diode, booster diode, efficiency diode 1)
Z	Voltage reference or voltage regulator diode 1)

---

1) For the type designation of a range see page 4.

The serial number consists of:

Three figures for semiconductor devices designed primarily for use in domestic equipment

One letter and two figures for semiconductor devices designed primarily for use in professional equipment

VERSION LETTER

A version letter can be used, for instance, for a diode with up-rated voltage, for a sub-division of a transistor type in different gain ranges, a low noise version of an existing transistor and for a diode, transistor, or thyristor with minor mechanical differences, such as finish of the leads, length of the leads etc. The letters never have a fixed meaning, the only exception being the letter R.

EXAMPLES

AC187	Germanium low power a.f. transistor intended primarily for domestic equipment
BYX27	Silicon rectifying diode intended primarily for professional equipment

TYPE DESIGNATION FOR A RANGE OF SEMICONDUCTOR DEVICES

The type designation of a range of variants of:

a) voltage reference or voltage regulator diodes (second letter Z)

b) rectifying diodes (second letter Y)

c) thyristors (second letter T)

d) radiation detectors

distinctly belonging to one basic type may be qualified by a suffix part which is clearly separated from the basic part by a dash (-)
The basic part being the same for the whole range, is in accordance with the designation code for discrete devices.

The suffix part consists of:

a) for voltage reference or voltage regulator diodes

one letter followed by the typical zener voltage and where appropriate the letter R ¹)
The first letter indicates the nominal tolerance of the zener voltage in %

A	1%
B	2%
C	5%
D	10%
E	15%

The typical zener voltage is related to the nominal current rating for the whole range. The letter V is used to denote the decimal point when this occurs.

b) for rectifying diodes

a number and where appropriate the letter R ¹)
The number generally indicates the maximum repetitive peak reverse voltage
For controlled avalanche types it indicates the maximum crest working reverse voltage

c) for thyristors

a number and where appropriate the letter R ¹)
The number generally indicates either the maximum repetitive peak reverse voltage or the maximum repetitive peak off-state voltage, whichever is lower
For controlled avalanche types it indicates the maximum crest working reverse voltage

---

¹) The letter R indicates reverse polarity (anode to stud). The normal polarity (cathode to stud) and symmetrical executions are not specially indicated.

d) for radiation detectors

a figure giving the depth of the depletion layer in μm and where appropriate a version letter if there are differences in resolution.

EXAMPLES

BZY88series	Range of silicon voltage regulator diodes for professional equipment
BZY88-C9V1	The particular type out of the range with a typical zener voltage of 9.1 V ± 5%
BYX13-1200	The particular normal polarity type out of the BYX13series with a maximum repetitive peak reverse voltage of 1200 V
BTW92-800R	The particular reverse polarity type out of the BTW92 thyristor range of which the lower maximum repetitive peak voltage is 800V

TYPE DESIGNATION FOR SEMICONDUCTOR RECTIFIER STACKS

The type designation consists of:

Three letters followed by a serial number

The first 2 letters indicate the type of stack:

OS	Denotes a semiconductor rectifier diode stack
OT	Denotes a semiconductor stack in which also thyristors are used

The third letter indicates the type of circuit:

A	Single phase half wave
B	Two phase half wave
C	Three phase half wave (three phase star)
D	Four phase half wave (four phase star)
E	Six phase half wave (six phase star)
F	Three phase double Y with interphase transformer
H	Single phase full wave (single phase bridge)
J	Single phase magnetic amplifier bridge
K	Three phase full wave (three phase bridge)
L	Four phase full wave (four phase bridge)
M	Voltage doubler (half a single phase full wave)
S	Miscellaneous (such as combinations of single diodes and passive components)

The serial number is sometimes followed by a suffix letter for the indication of variants.

Pro-Electron type numbers of whiskerless diodes

letters

Types in SOD-17 envelopes are identified by the colour of the cathode stud (not coloured for BAX) and a black body.
Types in SOD-27 (DO-35) by a light background colour.

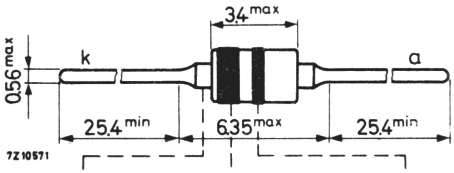
digits

Numbers are indicated by bands.
The broadest band indicates the cathode, its colour the first digit.
The colour of the second band indicates the second digit.

colour	letters SOD-17 (cathode stud)	 SOD-27 (background)	digit
not coloured	BAX	–	–
black	–	–	0
brown	–	BAS	1
red	BA	–	2
orange	–	–	3
yellow	–	BAT	4
green	–	BAV	5
blue	–	BAW	6
violet	–	–	7
grey	–	–	8
white	–	–	9

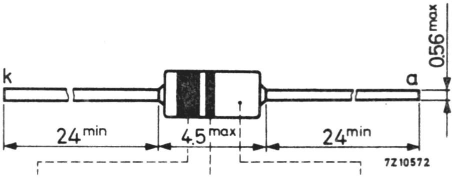
Examples

BAX13 in SOD-17 envelope


3,4 max
0,56 max
k
a
25,4 min
6,35 max
25,4 min
7Z10571

not coloured	brown	orange
BAX	1	3

BAW62 in SOD-27 envelope
(DO-35)


0,56 max
k
a
24 min
4,5 max
24 min
7Z10572

blue	red	body colour light blue
6	2	BAW

JEDEC assigned type numbers

(EIA-standard RS-236-B; June, 1963)

1. Prefix identification

   The prefix identification consisting of a first number symbol and the letter "N" shall not be indicated in the coding.

2. Banding systems

   The sequence number consisting of a two, three, or four digit number after the letter "N" may be coded as follows:

   2.1 Two-digit sequence numbers shall consist of a first black band and the sequence number in second and third bands of the colours indicated in Table 1. If a suffix letter is required, it shall be indicated with a fourth band as indicated in Table 1.

   2.2 Three-digit sequence numbers shall consist of the sequence number in first, second, and third bands of the colours indicated in Table 1. If a suffix letter is required, it shall be indicated with a fourth band as indicated in Table 1.

   2.3 Four-digit sequence numbers shall consist of the sequence number in four bands of the colours indicated in Table 1 with a fifth black band. If a suffix letter is required it shall be indicated as the fifth band and shall replace the black band.

3. Cathode identification and reading sequence

   3.1 A double-width band shall be used as the first band reading from cathode to anode ends.

   3.2 An alternative method is provided where equal width bands may be used. The bands shall be clearly grouped toward the cathode end, and shall be read from cathode to anode ends.

   3.3 Either of the above colour banding methods may be used in stead of the cathode designating symbol or other marking.

4. Colour bands

   The sequence numbers of the type numbers and suffix letters shall be indicated by the colours in Table 1.

TABLE 1

NUMBER	COLOUR	SUFFIX LETTER
0	black	not applicable
1	brown	A
2	red	B
3	orange	C
4	yellow	D
5	green	E
6	blue	F
7	violet	G
8	grey	H
9	white	J

RATING SYSTEMS

ACCORDING TO I.E.C. PUBLICATION 134

1. DEFINITIONS OF TERMS USED

1.1 Electronic device. An electronic tube or valve, transistor or other semiconductor device.

Note: This definition excludes inductors, capacitors, resistors and similar components.

1.2 Characteristic. A characteristic is an inherent and measurable property of a device. Such a property may be electrical, mechanical, thermal, hydraulic, electro-magnetic, or nuclear, and can be expressed as a value for stated or recognized conditions. A characteristic may also be a set of related values, usually shown in graphical form.

1.3 Bogey electronic device. An electronic device whose characteristics have the published nominal values for the type. A bogey electronic device for any particular application can be obtained by considering only those characteristics which are directly related to the application.

1.4 Rating. A value which establishes either a limiting capability or a limiting condition for an electronic device. It is determined for specified values of environment and operation, and may be stated in any suitable terms.

Note: Limiting conditions may be either maxima or minima.

1.5 Rating system. The set of principles upon which ratings are established and which determine their interpretation.

Note: The rating system indicates the division of responsibility between the device manufacturer and the circuit designer, with the object of ensuring that the working conditions do not exceed the ratings.

2. ABSOLUTE MAXIMUM RATING SYSTEM

Absolute maximum ratings are limiting values of operating and environmental conditions applicable to any electronic device of a specified type as defined by its published data, which should not be exceeded under the worst probable conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device, taking no responsibility for equipment variations, environmental variations, and the effects of changes in operating conditions due to variations in the characteristics of the device under consideration and of all other electronic devices in the equipment.

p.t.o.

The equipment manufacturer should design so that, initially and throughout life, no absolute maximum value for the intended service is exceeded with any device under the worst probable operating conditions with respect to supply voltage variation, equipment component variation, equipment control adjustment, load variations, signal variation, environmental conditions, and variations in characteristics of the device under consideration and of all other electronic devices in the equipment.

3. DESIGN MAXIMUM RATING SYSTEM

Design maximum ratings are limiting values of operating and environmental conditions applicable to a bogey electronic device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device, taking responsibility for the effects of changes in operating conditions due to variations in the characteristics of the electronic device under consideration.

The equipment manufacturer should design so that, initially and throughout life, no design maximum value for the intended service is exceeded with a bogey device under the worst probable operating conditions with respect to supply voltage variation, equipment component variation, variation in characteristics of all other devices in the equipment, equipment control adjustment, load variation, signal variation and environmental conditions.

4. DESIGN CENTRE RATING SYSTEM

Design centre ratings are limiting values of operating and environmental conditions applicable to a bogey electronic device of a specified type as defined by its published data, and should not be exceeded under normal conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device in average applications, taking responsibility for normal changes in operating conditions due to rated supply voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations in the characteristics of all electronic devices.

The equipment manufacturer should design so that, initially, no design centre value for the intended service is exceeded with a bogey electronic device in equipment operating at the stated normal supply voltage.

NOTE

It is common use to apply the Absolute Maximum System in semiconductor published data.

LETTER SYMBOLS

LETTER SYMBOLS FOR SEMICONDUCTOR DEVICES
excluding rectifier diodes, thyristors and integrated circuits

This system is based on the Recommendations of the INTERNATIONAL ELECTROTECHNICAL COMMISSION as published in I.E.C. Publication 148.

QUANTITY SYMBOLS

1. Instantaneous values of current, voltage and power, which vary with time are represented by the appropriate lower case letter.

   Examples: i, v, p

2. Maximum (peak), average, d.c. and root-mean-square values are represented by the appropriate upper case letter.

   Examples: I, V, P

SUBSCRIPTS FOR QUANTITY SYMBOLS

1. Total values are indicated by upper case subscripts.

   Examples: I_C, I_{CM}, $I_{C(AV)}$, i_C, V_{EB}

2. Values of varying components are indicated by lower case subscripts.

   Examples: i_c, I_c, v_{eb}, V_{eb}

3. To distinguish between maximum (peak), average, d.c. and root-mean-square values, the following subscripts are added:

   For maximum (peak) values : M or m

   For average values : (AV) or (av) (only if it is necessary to distinguish between d.c. and average)

   For d.c. values : no additional subscript

   For root-mean-square values : (RMS) or (rms)

   Examples: I_C, I_{cm}, $I_{C(AV)}$, $I_{c(rms)}$, $I_{C(RMS)}$

4. List of subscripts (examples, see figure 1)

A, a = Anode terminal
K, k = Cathode terminal
E, e = Emitter terminal
B, b = Base terminal or Substrate for MOS devices
C, c = Collector terminal
D, d = Drain terminal
(BR) = Break-down
X, x = Specified circuit
M, m = Maximum (peak) value
(AV), (av) = Average value
(RMS), (rms) = R.M.S. value
F, f = Forward
G, g = Gate terminal
R, r = As first subscript: Reverse. As second subscript: Repetitive
O, o = As third subscript: The terminal not mentioned is open circuited
S, s = As first or second subscript: Source terminal (for FETS only)
As second subscript: Non-repetitive (not for FETS)
As third subscript : Short circuit between the terminal not mentioned and the reference terminal
Z, z = Zener. (Replaces R to indicate the actual zener voltage, current or power of voltage reference or voltage regulator diodes)

5. Examples of the application of the rules:
Figure 1 represents a transistor collector current, consisting of a direct current and a signal, as a function of time.

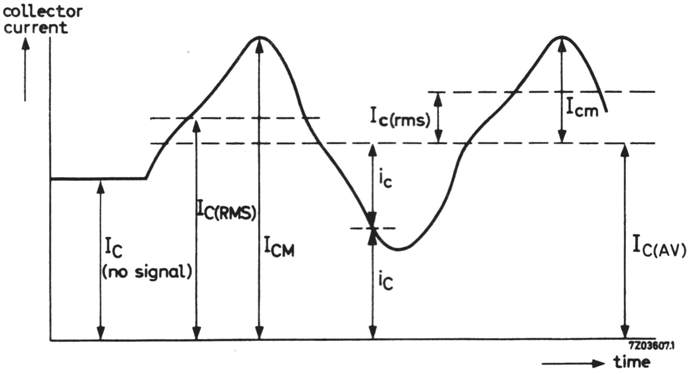


Fig.1

CONVENTIONS FOR SUBSCRIPT SEQUENCE

1. Currents

For transistors	the first subscript indicates the terminal carrying the current (conventional current flow from the external circuit into the terminal is positive)
For diodes	a forward current (conventional current flow into the anode terminal) is represented by the subscript F or f; a reverse current (conventional current flow out of the anode terminal) is represented by the subscript R or r.

2. Voltages

For transistors	normally, two subscripts are used to indicate the points between which the voltage is measured. The first subscript indicates one terminal point and the second the reference terminal. Where there is no possibility of confusion, the second subscript may be omitted.
For diodes	a forward voltage (anode positive with respect to cathode) is represented by the subscript F or f and a reverse voltage (anode negative with respect to cathode) by the subscript R or r.

3. Supply voltages

Supply voltages may be indicated by repeating the terminal subscript.

Examples: V_{EE}, V_{CC}, V_{BB}

The reference terminal may then be indicated by a third subscript.

Examples: V_{EEB}, V_{CCB}, V_{BBC}

4. In devices having more than one terminal of the same type, the terminal subscripts are modified by adding a number following the subscript and on the same line.

Example: V_{B2-E} voltage between second base and emitter

In multiple unit devices, the terminal subscripts are modified by a number preceding the terminal subscripts:

Example: V_{1B-2B} voltage between the base of the first unit and that of the second one.

ELECTRICAL PARAMETER SYMBOLS

1. The values of four pole matrix parameters or other resistances, impedances admittances, etc... inherent in the device, are represented by the lower case symbol with the appropriate subscripts.

   Examples: h_{ib}, z_{fb}, y_{oc}, h_{FE}

2. The four pole matrix parameters of external circuits and of circuits in which the device forms only a part are represented by the upper case symbols with the appropriate subscripts.

   Examples: H_i, Z_o, H_F, Y_R

SUBSCRIPTS FOR PARAMETER SYMBOLS

1. The static values of parameters are indicated by upper case subscripts.

   Examples: h_{IB}, h_{FE}

Note The static value is the slope of the line from the origin to the operating point on the appropriate characteristic curve, i.e. the quotient of the appropriate electrical quantities at the operating point.

2. The small-signal values of parameters are indicated by lower case subscripts.

   Examples: h_{ib}, z_{ob}

3. The first subscript, in matrix notation identifies the element of the four pole matrix.

   i (for 11) = input
   o (for 22) = output
   f (for 21) = forward transfer
   r (for 12) = reverse transfer

   Examples:
   $$V_1 = h_i I_1 + h_r V_2$$
   $$I_2 = h_f I_1 + h_o V_2$$

Notes 1) The voltage and current symbols in matrix notation are indicated by a single digit subscript.
The subscript 1 = input; the subscript 2 = output

2) The voltages and currents in these equations may be complex quantities.

4. The second subscript identifies the circuit configuration.

e = common emitter

b = common base

c = common collector

j = common terminal, general

Examples: (common base)

$$I_1 = y_{ib} V_{1b} + y_{rb} V_{2b}$$

$$I_2 = y_{fb} V_{1b} + y_{ob} V_{2b}$$

When the common terminal is understood, the second subscript may be omitted.

5. If it is necessary to distinguish between real and imaginary parts of the four pole parameters, the following notations may be used.

$Re(h_{ib})$ etc.. for the real part

$Im(h_{ib})$ etc.. for the imaginary part

LIST OF LETTER SYMBOLS IN ALPHABETICAL ORDER

Letter symbol	Definition
B	Bandwidth
b_{ib}, b_{ie}, b_{is}, b_{fb}, b_{fe}, b_{fs}, b_{ob}, b_{oe}, b_{os}, b_{rb}, b_{re}, b_{rs}.	See y parameters
C_c 1)	Collector capacitance (emitter open-circuited to a.c. and d.c.)
C_d 1)	Diode capacitance
C_e 1)	Emitter capacitance (collector open-circuited to a.c. and d.c.)
C_{ib}, C_{ie}, C_{is}, C_{fb} C_{fe}, C_{fs}, C_{ob}, C_{oe} C_{os}, C_{rb}, C_{re}, C_{rs}	See y parameters
d	Distortion
F	Noise figure
f	Frequency
f_{hfb}, f_{hfe}, f_{yfe}	Cut-off frequency (frequency at which the parameter indicated by the subscript is 0.7 of its low frequency value)
f_T	Transition frequency (Gain-bandwidth product)
g_{ie}, g_{ib}, g_{oe}, g_{ob}	See y parameters
G_p	Power gain
G_S	Source conductance
G_{tr}	Transducer gain
G_{UM}	Maximum unilateralised power gain
G_v	Voltage gain

---

1) As an exception to the general rule for electrical parameters capacitances are represented by the upper-case letter.

Letter symbol	Definition
h_{FB}, h_{FC}, h_{FE}	D.C. current gain (static value of the forward current transfer ratio; output voltage held constant)
h_{fb}, h_{fc}, h_{fe}	Small-signal current gain (small-signal value of the forward current transfer ratio; output short-circuited to a.c.)
h_{IB}, h_{IC}, h_{IE}	Static value of the input resistance (output voltage held constant)
h_{ib}, h_{ic}, h_{ie}	Small-signal value of the input impedance (output short-circuited to a.c.)
h_{OB}, h_{OC}, h_{OE}	Static value of the output conductance (input current held constant)
h_{ob}, h_{oc}, h_{oe}	Small-signal value of the output admittance (input open-circuited to a.c.)
h_{RB}, h_{RC}, h_{RE}	Static value of the reverse voltage transfer ratio (input current held constant)
h_{rb}, h_{rc}, h_{re}	Small-signal value of the reverse voltage transfer ratio (input open-circuited to a.c.)
I_B, I_C, I_D, I_E, I_G, I_S	Total d.c. (or average) current
I_b, I_c, I_d, I_e, I_g, I_s	Varying component of the current
i_B, i_C, i_D, i_E, i_G, i_S	Instantaneous total value of the current
i_b, i_c, i_d, i_e, i_g, i_s	Instantaneous value of the varying component of the current
$I_{B(AV)}$, $I_{C(AV)}$, $I_{E(AV)}$	Total average current (to distinguish between average and d.c. if necessary)
I_{BEX}, I_{CEX}	Total base, respectively collector current under specified conditions. These symbols are commonly used in case of a reverse biased emitter junction
I_{BM}, I_{CM}, I_{EM}	Maximum (peak) value of the total current
I_{bm}, I_{cm}, I_{em}	Maximum (peak) value of the varying component of the current
I_{CBO}	Collector cut-off current (open emitter)
I_{CEO}	Collector cut-off current (open base)
I_{CBS} or I_{CES}	Collector cut-off current (emitter short-circuited to base)

Letter symbol	Definition
I_{DSS}	Drain current (source short-circuited to gate)
I_{EBO}	Emitter cut-off current (open collector)
I_F	Total forward current of a diode (d.c. or average)
i_F	Instantaneous total value of the forward current of a diode
$I_{F(AV)}$	Total average forward current of a diode (to distinguish between average and d.c. if necessary)
I_{FM}	Peak forward current of a diode
I_{GSS}	Gate cut-off current (source short-circuited to drain)
I_i, I_o	Input, respectively output current of a specified circuit
I_R	Total reverse (cut-off) current of a diode
i_R	Instantaneous total value of the reverse current of a diode
I_{RRM}	Repetitive peak reverse current of a diode
I_{RSM}	Non-repetitive peak reverse current of a diode
I_{SDS}	Source cut-off current (drain short-circuited to gate)
I_Z	Zener current (d.c. or average)
I_{ZM}	Peak zener current
I_{ZS}	Non-repetitive zener current
P_i, P_o	Input, respectively output power of a specified circuit
P_{tot}	Total power dissipation in the device
P_Z	Zener power dissipation
P_{ZM}	Peak zener power dissipation
P_{ZSM}	Non-repetitive peak zener power dissipation
Q_s	Reverse recovery charge

Letter symbol	Definition
r_D	Diode (internal) series resistance
r_{DS}	Drain-source resistance
r_{GS}	Gate-source resistance
R_L	Load resistance
R_S	Source resistance
R_{th}	Thermal resistance
$R_{th\ j\text{-}a}$	Thermal resistance from junction to ambient
$R_{th\ j\text{-}mb}$	Thermal resistance from junction to mounting base
$R_{th\ j\text{-}c}$	Thermal resistance from junction to case
$R_{th\ mb\text{-}h}$	Thermal resistance from mounting base to heatsink (contact thermal resistance)
r_Z	Dynamic-slope resistance of a zener diode
S_Z	Temperature coefficient of the operating voltage of a zener diode
T_{amb}	Ambient temperature
T_{case}	Case temperature
t_d ; t_f	Delay time; fall time
t_{fr}	Forward recovery time of a diode
T_j	Junction temperature
t_{off}	Turn-off time ($t_{off} = t_s + t_f$)
t_{on}	Turn-on time ($t_{on} = t_d + t_r$)
t_r	Rise time
t_{rr}	Reverse recovery time of a diode
t_s	Storage time
T_{stg}	Storage temperature
V_{BB}, V_{CC}, V_{EE}	Supply voltage
V_{BE}, V_{CB}, V_{CE}, V_{EB}	Total value of the voltage (d.c. or average)
V_{be}, V_{cb}, V_{ce}, V_{eb}	Varying component of the voltage
v_{BE}, v_{CB}, v_{CE}, v_{EB}	Instantaneous value of the total voltage
v_{be}, v_{cb}, v_{ce}, v_{eb}	Instantaneous value of the varying component of the voltage

Letter symbols	Definition
V_{BEfl}	Base-emitter floating voltage (open base)
V_{BEsat}	Saturation voltage at specified bottoming conditions
$V_{(BR)}$	Breakdown voltage
$V_{(BR)CBO}$, $V_{(BR)CEO}$, $V_{(BR)EBO}$	Breakdown voltage between the terminal indicated by the first subscript and the reference terminal (second subscript) when the third terminal is open circuited
$V_{(BR)CER}$	Collector-emitter breakdown voltage with a specified resistance between emitter and base
$V_{(BR)CES}$	Collector-emitter breakdown voltage with the emitter short circuited to the base
V_{CBO}, V_{CEO}, V_{DGO}, V_{EBO}, V_{GSO}	Voltage of the terminal indicated by the first subscript w.r.t. the reference terminal (second subscript) with the third terminal open circuited
V_{CBOM}, V_{CEOM}	Peak value of V_{CBO}, V_{CEO}
V_{CEK}	Knee voltage at specified conditions
V_{CER}	Collector-emitter voltage with a specified resistance between emitter and base
V_{CERM}	Peak value of V_{CER}
V_{CES}	Collector-emitter voltage with the emitter short circuited to the base
V_{CEsat}	Saturation voltage at specified bottoming conditions
$V_{CE.sust}$	Collector-emitter sustaining voltage under the condition, indicated by the third subscript
V_{CEX}	Collector-emitter voltage in a specified circuit. This symbol is commonly used to indicate a reverse biased emitter junction
V_{DSS}	Drain-source voltage with the source short-circuited to the gate
V_{EBfl}	Emitter-base floating voltage (open emitter)
V_F	Continuous forward voltage of a diode
V_{FM}	Peak forward voltage of a diode

Letter symbol	Definition	
V_i, V_o	Input, respectively output voltage of a specified circuit	
$V_{(P)GS}$	Gate-source cut-off voltage	
V_R	Continuous reverse voltage of a diode	
V_{RM}	Peak reverse voltage of a diode	
V_{RSM}	Non-repetitive peak reverse voltage of a diode	
V_Z	Operating voltage (zener voltage) of a zener diode	
y_{ib}, y_{ie}, y_{is}	Input admittance	Output short circuited to a.c.
b_{ib}, b_{ie}, b_{is}		
g_{ib}, g_{ie}, g_{is}	Input conductance	
C_{ib}, C_{ie}, C_{is}	Input capacitance	
φ_{ib}, φ_{ie}, φ_{is}	Phase angle of input admittance	
y_{fb}, y_{fe}, y_{fs}	Transfer admittance	Output short circuited to a.c.
b_{fb}, b_{fe}, b_{fs}		
g_{fb}, g_{fe}, g_{fs}	Transfer conductance	
C_{fb}, C_{fe}, C_{fs}	Transfer capacitance	
φ_{fb}, φ_{fe}, φ_{fs}	Phase angle of transfer admittance	
y_{ob}, y_{oe}, y_{os}	Output admittance	Input short circuited to a.c.
b_{ob}, b_{oe}, b_{os}		
g_{ob}, g_{oe}, g_{os}	Output conductance	
C_{ob}, C_{oe}, C_{os}	Output capacitance	
φ_{ob}, φ_{oe}, φ_{os}	Phase angle of output admittance	
y_{rb}, y_{re}, y_{rs}	Feedback admittance	Input short circuited to a.c.
b_{rb}, b_{re}, b_{rs}		
g_{rb}, g_{re}, g_{rs}	Feedback conductance	
C_{rb}, C_{re}, C_{rs}	Feedback capacitance	
φ_{rb}, φ_{re}, φ_{rs}	Phase angle of feedback admittance	
Z_{th}	Transient thermal impedance	

LETTER SYMBOLS
FOR RECTIFIER DIODES AND THYRISTORS

This system is based on the Recommendations of the INTERNATIONAL ELECTROTECHNICAL COMMISSION.

QUANTITY SYMBOLS

1. Instantaneous values of current, voltage and power, which vary with time are represented by the appropriate lower case letter.

   Examples: i, v, p

2. Maximum (peak or crest), average, d. c. and root-mean-square values are represented by the appropriate upper case letter.

   Examples: I, V, P

SUBSCRIPTS FOR QUANTITY SYMBOLS

1. Total values are indicated by upper case subscripts.
2. Values of varying components are indicated by lower case subscripts.
3. For power rectifier diodes and thyristors the **terminals** are not indicated in the subscripts, except for the gate-terminal of thyristors.
4. List of subscripts:

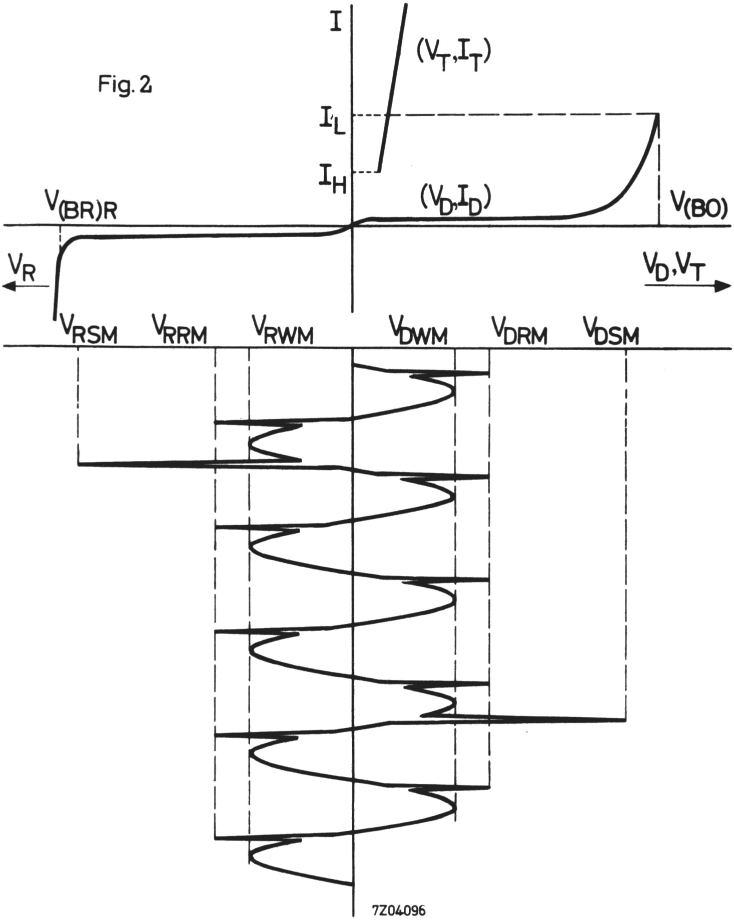
G, g = Gate terminal
F, f = Forward 1)
D, d = Forward off-state 1); non trigger (gate voltage or current)
T, t = Forward on-state 1); trigger (gate voltage or current)
R, r = As first subscript; Reverse
As second subscript: Repetitive
(AV), (av) = Average value
M, m = Maximum (peak or crest) value
(RMS), (rms) = R.M.S. value
(BR) = Breakdown
(BO) = Breakover
H = Holding
L = Latching
Q, q = Turn-off
S, s = As a second subscript: Non-repetitive
W = Working

---

1) For the anode-cathode voltage of thyristors F is replaced either by D or by T, to distinguish between "off-state" (non triggered) and "on-state" (triggered).

5. Examples of the application of the rules.
   Fig. 2 represents a simplified thyristor characteristic together with an anode-cathode voltage as a function of time (no gate signal).

Fig. 2


I
(V_T, I_T)
I_L
I_H
$V_{(BR)R}$
(V_D, I_D)
$V_{(BO)}$
V_R
V_D, V_T
V_{RSM}
V_{RRM}
V_{RWM}
V_{DWM}
V_{DRM}
V_{DSM}
7Z04096

LIST OF LETTER SYMBOLS IN ALPHABETICAL ORDER

for Rectifier Diodes (R) and Thyristors (T)

Instantaneous values (i, p, v) and a.c. components (lower case subscripts) have been omitted.

Letter symbol	R	T	Description
I_{DM}	–	T	Peak off-state current (d.c.)
I_F	R	–	Forward current (d.c. or average)
$I_{F(AV)}$	R	–	Total average forward current (to distinguish between average and d.c. if necessary)
I_{FGM}	–	T	Forward peak gate current
$I_{F(RMS)}$	R	–	R.M.S. value of the forward current
I_{FRM}	R	–	Repetitive peak forward current
I_{FSM}	R	–	Non-repetitive peak forward current
I_H	–	T	Holding current
I_{GT}	–	T	Gate current
I_L	–	T	Latching current (pick up current, I_P)
I_{RG}	–	T	Reverse gate current
I_{RM}	R	T	Peak reverse current (d.c.)
I_{RRM}	R	T	Repetitive peak reverse current
I^2t	R	T	I squared t for fusing
I_T	–	T	On-state current (d.c.)
$-dI/dt$	–	T	Rate of change of commutation current
dI_T/dt	–	T	Rate of rise of on-state current
$I_{T(AV)}$	–	T	Average on-state current
I_{TRM}	–	T	Repetitive peak on-state current
$I_{T(RMS)}$	–	T	R.M.S. value of the on-state current
I_{TSM}	–	T	Non-repetitive peak on-state current
$I_{TS(RMS)}$	–	T	R.M.S. value of the non-repetitive on-state current
$P_{G(AV)}$	–	T	Average gate power dissipation
P_{GM}	–	T	Peak gate power dissipation
$P_{R(AV)}$	R	T	Average reverse power dissipation

Letter symbol	R	T	Description
P_{RRM}	R	T	Repetitive peak reverse power dissipation
P_{RSM}	R	T	Non-repetitive peak reverse power dissipation
R_{th}	R	T	Thermal resistance
T_{amb}	R	T	Ambient temperature
T_{mb}	R	T	Mounting base temperature
t_d; t_f	R	T	Delay time; fall time
T_j	R	T	Junction temperature
t_{on}	R	T	Turn-on time ($t_{on} = t_d + t_r$)
t_q	R	T	Turn-off time
t_r	R	T	Rise time
T_{stg}	R	T	Storage temperature
$V_{(BO)}$	–	T	Forward breakover voltage
$V_{(BR)R}$	R	T	Reverse avalanche breakdown voltage
V_D	–	T	Continuous off-state voltage
$\frac{dV_D}{dt}$	–	T	Rate of rise of off-state voltage
V_{DRM}	–	T	Repetitive peak off-state voltage
V_{DSM}	–	T	Non-repetitive peak off-state voltage
V_{DWM}	–	T	Crest working off-state voltage
V_F	R	–	Continuous forward voltage
V_{FGM}	–	T	Forward peak voltage, gate-cathode
V_{GD}	–	T	Gate-cathode voltage that will not trigger any device
V_{GT}	–	T	Gate-cathode voltage that will trigger all devices
V_R	R	T	Continuous reverse voltage
V_{RGM}	–	T	Reverse peak voltage, gate-cathode
V_{RRM}	R	T	Repetitive peak reverse voltage
V_{RSM}	R	T	Non-repetitive peak reverse voltage
V_{RWM}	R	T	Crest working reverse voltage
V_T	–	T	Continuous on-state voltage
Z_{th}	R	T	Transient thermal impedance

Signal diodes

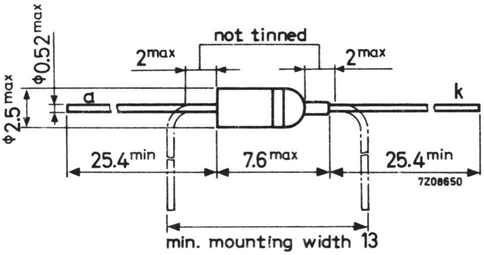
POINT CONTACT DIODE

Germanium point contact diode in a subminiature all glass DO-7 envelope primarily intended for use in a.m. detector and ratio detector circuits.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	30	V
Repetitive peak reverse voltage	V_{RRM}	max.	45	V
Forward current (d.c.)	I_F	max.	35	mA
Repetitive peak forward current	I_{FRM}	max.	100	mA
Operating ambient temperature	T_{amb}	max.	60	°C
Forward voltage at I_F = 10 mA	V_F	<	2.2	V

MECHANICAL DATA Dimensions in mm

DO-7


Φ0.52 max
Φ2.5 max
not tinned
2 max
2 max
a
k
25.4 min
7.6 max
25.4 min
7Z08650
min. mounting width 13

The white band indicates the cathode

RATINGS (Limiting values) [1]

Voltages

Continuous reverse voltage	V_R	max.	30	V
Repetitive peak reverse voltage	V_{RRM}	max.	45	V

Currents

Forward current (d.c.)	I_F	max.	35	mA
Average rectified forward current (averaged over any 50 ms period)	I_{FAV}	max.	35	mA
Repetitive peak forward current	I_{FRM}	max.	100	mA
Non repetitive peak forward current ($t < 1$ s)	I_{FSM}	max.	200	mA

Temperatures

Storage temperature	T_{stg}	−55 to +75		°C
Operating ambient temperature	T_{amb}	max.	60	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.45	°C/mW

---

[1] Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

CHARACTERISTICS

Forward voltage at T_{amb} = 25 °C

I_F = 0.1 mA	V_F	typ.	0.23	V
		<	0.30	V
I_F = 1 mA	V_F	typ.	0.56	V
		<	0.88	V
I_F = 10 mA	V_F	typ.	1.5	V
		<	2.2	V
I_F = 30 mA [1]	V_F	typ.	2.8	V
		<	4.0	V

Forward voltage at T_{amb} = 60 °C

I_F = 0.1 mA	V_F	typ.	0.16	V
		<	0.25	V
I_F = 1 mA	V_F	typ.	0.50	V
		<	0.80	V
I_F = 10 mA	V_F	typ.	1.4	V
		<	2.1	V
I_F = 30 mA [1]	V_F	typ.	2.6	V
		<	3.8	V

Reverse current at T_{amb} = 25 °C

V_R = 0.1 V	I_R	typ.	0.35	μA
		<	1.0	μA
V_R = 1.5 V	I_R	typ.	0.8	μA
		<	2.8	μA
V_R = 10 v	I_R	typ.	4.5	μA
		<	18	μA
V_R = 30 V	I_R	typ.	35	μA
		<	150	μA
V_R = 45 V	I_R	typ.	90	μA
		<	350	μA

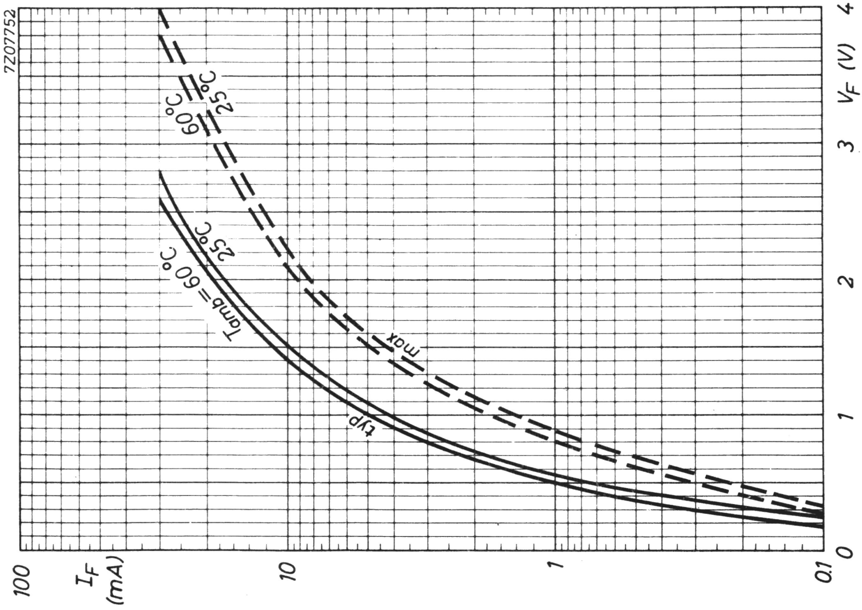
Reverse current at T_{amb} = 60 °C

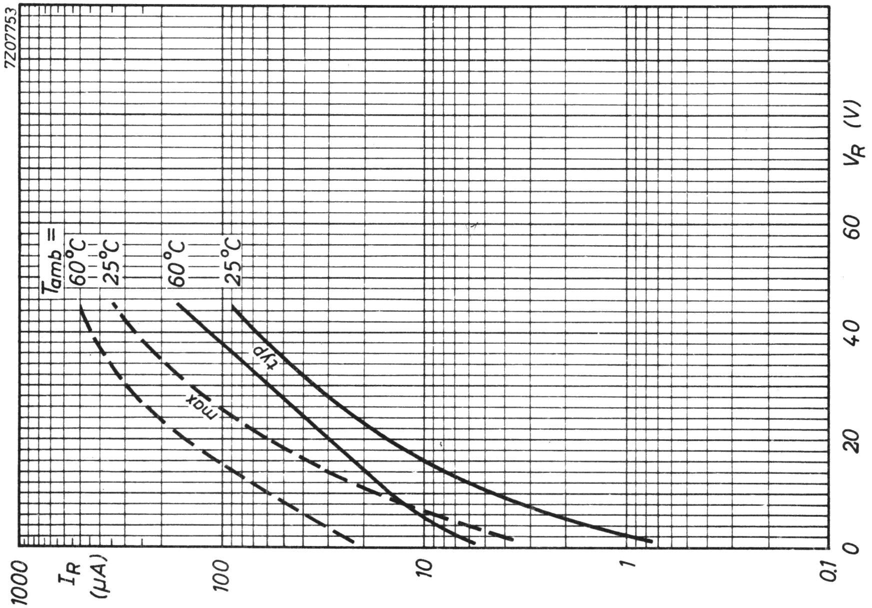
V_R = 0.1 V	I_R	typ.	4.5	μA
		<	12	μA
V_R = 1.5 V	I_R	typ.	6	μA
		<	25	μA
V_R = 10 V	I_R	typ.	16	μA
		<	60	μA
V_R = 30 V	I_R	typ.	60	μA
		<	300	μA
V_R = 45 V	I_R	typ.	170	μA
		<	500	μA

---

[1] Measured under pulsed conditions to prevent excessive dissipation.

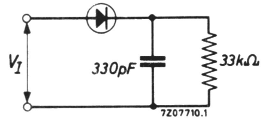
7Z3 1182


7Z07752
I_F (mA)
100
10
1
0.1
V_F (V)
0
1
2
3
4
T_{amb} = 60 °C
25 °C
typ
60 °C
25 °C
max


7Z07753
I_R (µA)
1000
100
10
1
0.1
V_R (V)
0
20
40
60
T_{amb} =
60°C
25°C
max
60°C
25°C
typ

APPLICATION INFORMATION

Measuring circuit at T_{amb} = 25 °C


V_I
330pF
33kΩ
7Z07710.1

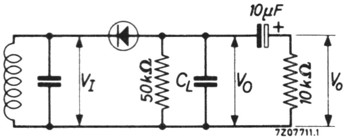
$V_{I(RMS)}$ = 3 V
f = 10.7 MHz

η typ. 85 %
R_d typ. 15 kΩ
13.5 to 19 kΩ

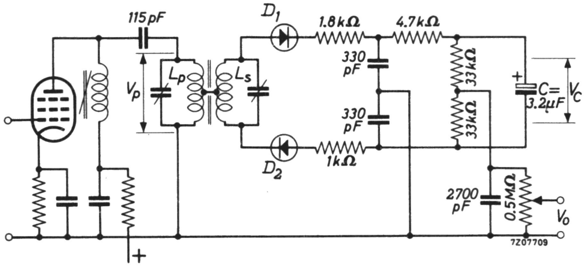
Diode in an a.m. detector circuit at T_{amb} = 25 °C

$V_{I(RMS)}$ = 0.1 V
f = 0.5 MHz

V_O typ. 55 mV
$V_{o(rms)}$ typ. 4.5 mV 1)
R typ. 40 kΩ 2)


10μF
+
V_I
50kΩ
C_L
V_O
10kΩ
V_o
7Z07711.1

Matched pair in a ratio detector circuit


115pF
D_1
1.8kΩ
4.7kΩ
330 pF
330 pF
33kΩ
33kΩ
+
C= 3.2μF
V_C
V_p
L_p
L_s
D_2
1kΩ
2700 pF
0.5MΩ
V_o
+
7Z07709

L_p = 7.4 μH
Q_0 = 80 unloaded
R = 40 kΩ unloaded
Tap = 0.5
L_s = 4.4 μH
Q_0 = 150 unloaded
R = 45 kΩ unloaded
kQ = 0.8 3)
f_0 = 10.7 MHz
Δf = 15 kHz
m = 0.3

a.m. suppression factor at V_C = 2 to 20 V

f = f_0 α ≥ 30

f = f_0 ± 25 kHz α ≥ 15

For optimum a.m. suppression D_1 must be that diode of the matched pair which has the better dynamic forward characteristic.

---

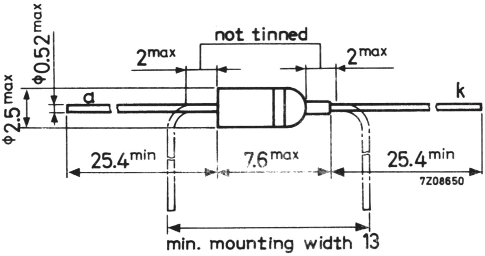
1) Modulation factor m = 0.3
2) Modulation factor m = 0
3) Measured in the circuit with V_p = 350 mV

POINT CONTACT DIODE

Germanium point contact diode in a subminiature all glass DO-7 envelope primarily intended for computer applications.

MECHANICAL DATA Dimensions in mm

DO-7


φ0.52 max
φ2.5 max
2 max
not tinned
2 max
a
k
25.4 min
7.6 max
25.4 min
7Z08650
min. mounting width 13

The coloured band indicates the cathode

RATINGS (Limiting values according to the Absolute Maximum System as defined in IEC publication 134)

Voltages

Continuous reverse voltage	V_R	max.	60	V
Repetitive peak reverse voltage	V_{RRM}	max.	90	V

Currents

Forward current (d.c.)	I_F	max.	35	mA
Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	35	mA
Repetitive peak forward current	I_{FRM}	max.	150	mA
Non repetitive peak forward current	I_{FSM}	max.	200	mA

Temperatures

Storage temperature	T_{stg}		-55 to +75	°C
Junction temperature	T_j	max.	75	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	0.4	°C/mW

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Forward voltage

I_F = 5 mA	V_F	typ.	0.72	V
		<	1.0	V
I_F = 30 mA	V_F	typ.	2.1	V
			1.5 to 3.0	V

Reverse current

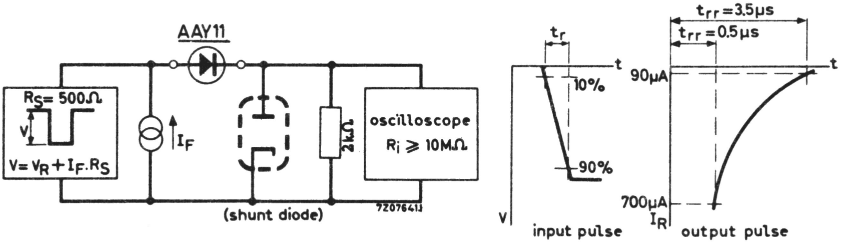
V_R = 50 V	I_R	typ.	25	μA
		<	65	μA
V_R = 50 V; T_j = 60 °C	I_R	<	150	μA
V_R = 90 V	I_R	typ.	130	μA
		<	250	μA

Reverse recovery current when switched from

I_F = 30 mA to V_R = 35 V; R_L = 2.5 kΩ

measured at t_{rr} = 0.5 μs	I_R	typ.	200	μA
		<	700	μA
measured at t_{rr} = 3.5 μs	I_R	typ.	25	μA
		<	90	μA

Test circuit


AAY11
R_S = 500Ω
V
V = $V_R + I_F.R_S$
I_F
(shunt diode)
2kΩ
oscilloscope
$R_i \geq$ 10MΩ
7207641J
t_r
t
10%
90%
V
input pulse
t_{rr}=3.5μs
t_{rr}=0.5μs
t
90μA
700μA
I_R
output pulse

Reverse pulse:

Rise time	t_r	≤	0.1	μs
Duty cycle	δ	=	0.5	
Frequency	f	=	50	kHz
Circuit capacitance	C	≤	30	pF (C = Oscilloscope + parasitical capacitance)

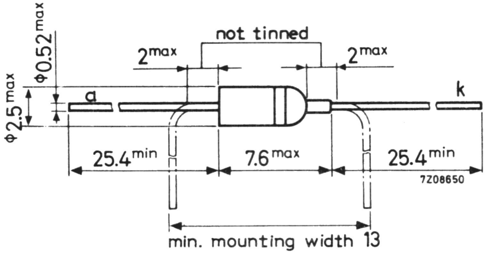
POINT CONTACT DIODE

Germanium point contact diode in a subminiature all glass DO-7 envelope primarily intended for computer applications.

MECHANICAL DATA

Dimensions in mm

DO-7



not tinned
2 max
2 max
Φ0.52 max
Φ2.5 max
a
k
25.4 min
7.6 max
25.4 min
7Z08650
min. mounting width 13

The coloured band indicates the cathode

RATINGS (Limiting values according to the Absolute Maximum System as defined in IEC publication 134)

Voltage				
Continuous reverse voltage	V_R	max.	15	V
Currents				
Forward current (d.c.)	I_F	max.	20	mA
Peak forward current	I_{FM}	max.	50	mA
Temperatures				
Storage temperature	T_{stg}	-65 to +75		^oC
Junction temperature	T_j	max.	75	^oC
Operating ambient temperature	T_{amb}	max.	60	^oC

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	0.75	$^oC/mW$

CHARACTERISTICS $T_j = 25\ ^{o}C$ unless otherwise specified

Forward voltage

$I_F = 2$ mA	V_F		0.25 to 0.45	V
$I_F = 2$ mA; $T_j = 60\ ^{o}C$	V_F		0.19 to 0.39	V
$I_F = 10$ mA	V_F		0.40 to 0.80	V
$I_F = 10$ mA; $T_j = 60\ ^{o}C$	V_F		0.34 to 0.74	V
$I_F = 50$ mA	V_F		0.60 to 1.5	V
$I_F = 50$ mA; $T_j = 60\ ^{o}C$	V_F		0.54 to 1.44	V

Reverse current

$V_R = 5$ V; $T_{amb} = 60\ ^{o}C$	I_R	<	30	µA
$V_R = 5$ V; $T_{amb} = 25\ ^{o}C$	I_R	<	10	µA
$V_R = 15$ V; $T_{amb} = 60\ ^{o}C$	I_R	<	100	µA
$V_R = 15$ V; $T_{amb} = 25\ ^{o}C$	I_R	<	60	µA

Diode capacitance

$V_R = 1$ V; f = 0.5 MHz	C_d	<	1.2	pF

Reverse recovery current when switched from

$I_F = 3$ mA to $V_R = 5$ V; $R_L = 0.5\ k\Omega$ measured at $t_{rr} = 50$ ns	I_R	<	0.5	mA

Reverse recovery time when switched from

$I_D = 3$ mA to $V_R = 1$ V; $R_L = 100\ \Omega$ measured at $I_R = 1$ mA	t_{rr}	typ.	5	ns
		<	12	ns

GOLD BONDED DIODES

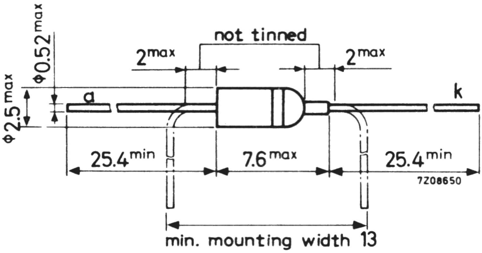
Gold bonded germanium diodes in subminiature all glass DO-7 envelope, intended for switching applications and general purposes.

QUICK REFERENCE DATA

			AAY30	AAY32	
Continuous reverse voltage	V_R	max.	30	30	V
Repetitive peak reverse voltage	V_{RRM}	max.	50	30	V
Forward current (d.c.)	I_F	max.	110	110	mA
Repetitive peak forward current	I_{FRM}	max.	400	150	mA
Junction temperature	T_j	max.	75	85	°C
Forward voltage at I_F = 150 mA	V_F	<	1.0	1.0	V
Recovered charge when switched from I_F = 10 mA to V_R = 10 V	Q_s	<	500	150	pC

MECHANICAL DATA Dimensions in mm

DO-7


φ0.52 max
not tinned
2 max
2 max
φ2.5 max
a
k
25.4 min
7.6 max
25.4 min
7Z08650
min. mounting width 13

The coloured band indicates the cathode

RATINGS (Limiting values) [1]

			AAY30	AAY32	
Voltages					
Continuous reverse voltage	V_R	max.	30	30	V
Repetitive peak reverse voltage	V_{RRM}	max.	50	30	V
Non repetitive peak reverse voltage ($t < 1$ s)	V_{RSM}	max.	50	30	V
Currents					
Forward current (d.c.)	I_F	max.	110	110	mA
Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	110	110	mA
Repetitive peak forward current	I_{FRM}	max.	400	150	mA
Non repetitive peak forward current ($t < 1$ s)	I_{FSM}	max.	500	200	mA

Temperatures

Storage temperature	AAY30	T_{stg}	-65 to +75	°C
	AAY32	T_{stg}	-65 to +85	°C
Junction temperature	AAY30	T_j	max. 75	°C
	AAY32	T_j	max. 85	°C

THERMAL RESISTANCE

From junction to ambient in free air $R_{th\,j\text{-}a} = 0.45$ °C/mW

---

[1] Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

CHARACTERISTICS

Forward voltage at T_j = 25 °C

I_F = 0.1 mA	V_F	<	0.20	V
I_F = 1.0 mA	V_F	<	0.31	V
I_F = 10 mA	V_F	<	0.45	V
I_F = 30 mA	V_F	<	0.60	V
I_F = 150 mA	V_F	<	1.0	V

Forward voltage at T_j = 60 °C

I_F = 0.1 mA	V_F	<	0.14	V
I_F = 1.0 mA	V_F	<	0.26	V
I_F = 10 mA	V_F	<	0.41	V
I_F = 30 mA	V_F	<	0.57	V
I_F = 150 mA	V_F	<	0.99	V

Reverse current at T_j = 25 °C

			AAY30	AAY32	
V_R = 1.5 V	I_R	<	9	2.5	μA
V_R = 10 V	I_R	<	15	8	μA
V_R = 20 V	I_R	<	25	25	μA
V_R = 25 V	I_R	<	35	35	μA
V_R = 30 V	I_R	<	50	70	μA
V_R = 50 V	I_R	<	200	–	μA

Reverse current at T_j = 60 °C

V_R = 1.5 V	I_R	<	40	15	μA
V_R = 10 V	I_R	<	60	30	μA
V_R = 20 V	I_R	<	120	60	μA
V_R = 25 V	I_R	<	150	100	μA
V_R = 30 V	I_R	<	200	200	μA
V_R = 50 V	I_R	<	500	–	μA

Diode capacitance

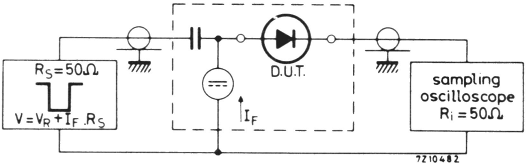
V_R = 1 V; f = 1 MHz	C_d	<	1.0	1.5	pF

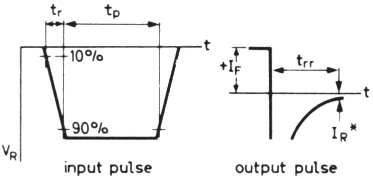
CHARACTERISTICS (continued) $T_j = 25\ ^{o}C$

Reverse recovery time when switched from $I_F = 10$ mA to $V_R = 1$ V; $R_L = 100\ \Omega$

Measured at $I_R = 10\ \%$ of $\frac{V_R}{R_L}$	AAY30	t_{rr}	<	150	ns
	AAY32	t_{rr}	<	50	ns

Test circuit:


R
$R_S = 50\Omega$
$V = V_R + I_F.R_S$
D.U.T.
I_F
sampling oscilloscope
$R_i = 50\Omega$
7Z10482


t_r
t_p
t
10%
90%
V_R
input pulse
$+I_F$
t_{rr}
t
I_R*
output pulse

*) $I_R = 10\ \%$ of $\frac{V_R}{R_L}$

Reverse pulse: Rise time $t_r = 0.6$ ns

Pulse duration $t_p = 100$ ns

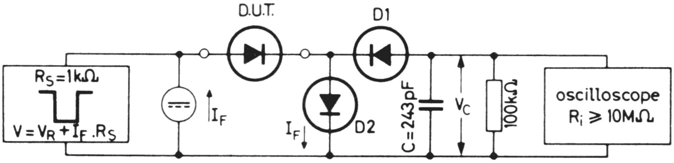
Duty cycle $\delta = 0.05$

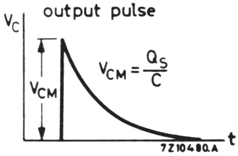
Circuit capacitance C < 1 pF (C = Oscilloscope + parasitical capacitance)

Recovered charge when switched from $I_F = 10$ mA to $V_R = 10$ V; $R_L = 1$ kΩ

AAY30	Q_s	<	500	pC
AAY32	Q_s	<	150	pC

Test circuit:


D.U.T.
D1
$R_S = 1k\Omega$
$V = V_R + I_F.R_S$
I_F
I_F
D2
C=243pF
V_C
100kΩ
oscilloscope
$R_i \geqslant 10M\Omega$

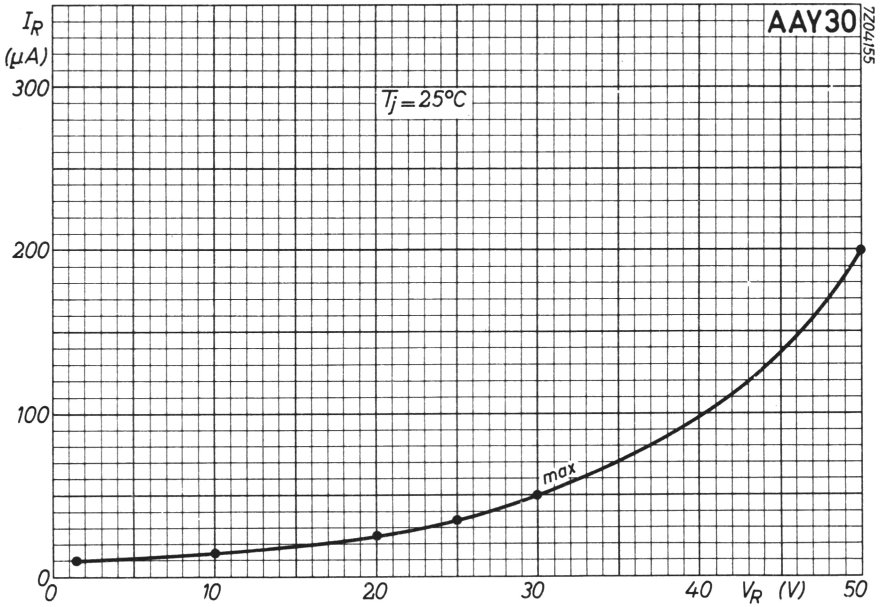

V_C
output pulse
V_{CM}
$V_{CM} = \frac{Q_S}{C}$
t
7Z10480.A

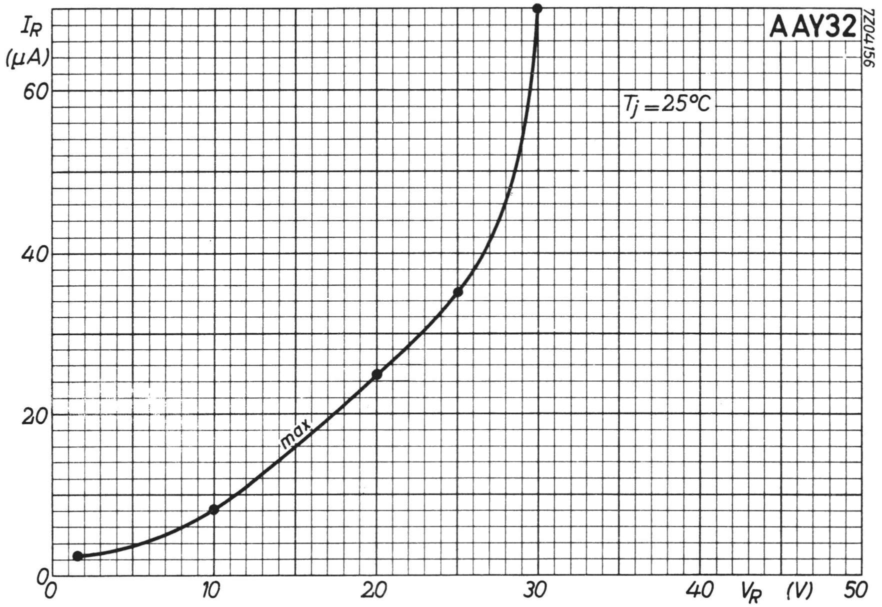
D1 = D2 = BAW62

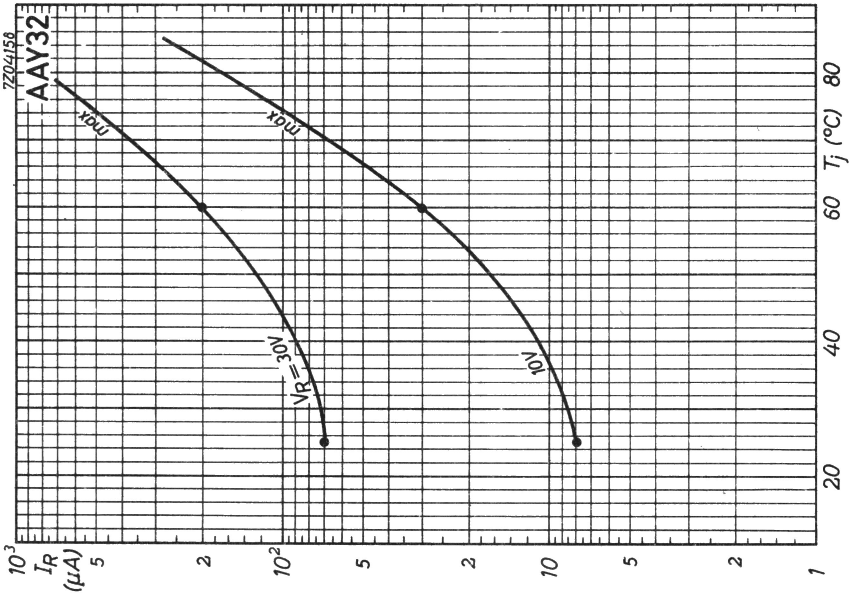
Reverse pulse: Rise time $t_r = 2$ ns

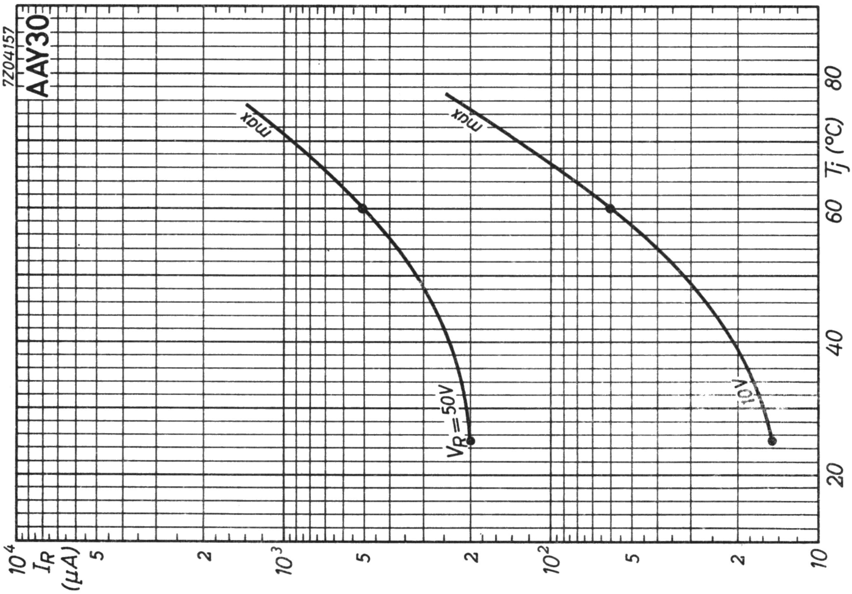
Pulse duration $t_p = 0.4\ \mu s$

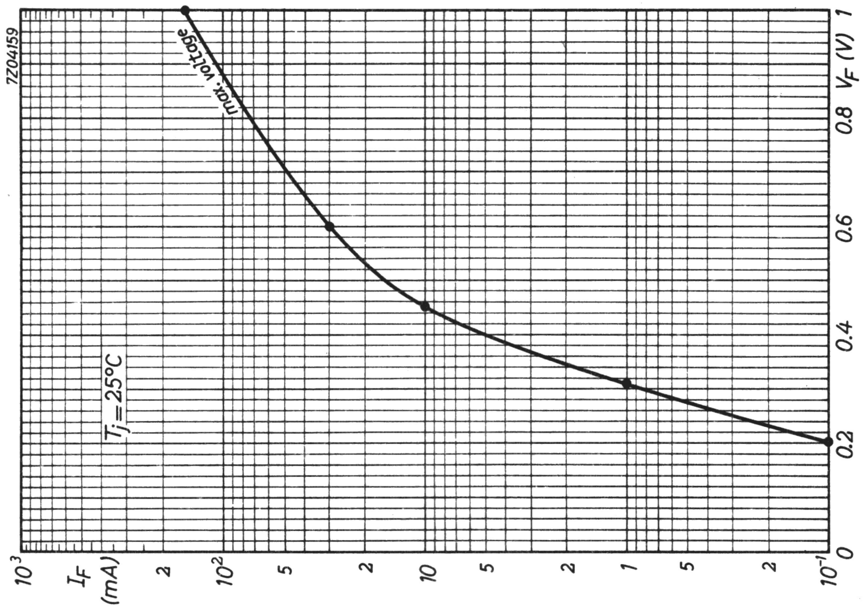
Duty cycle $\delta = 0.02$

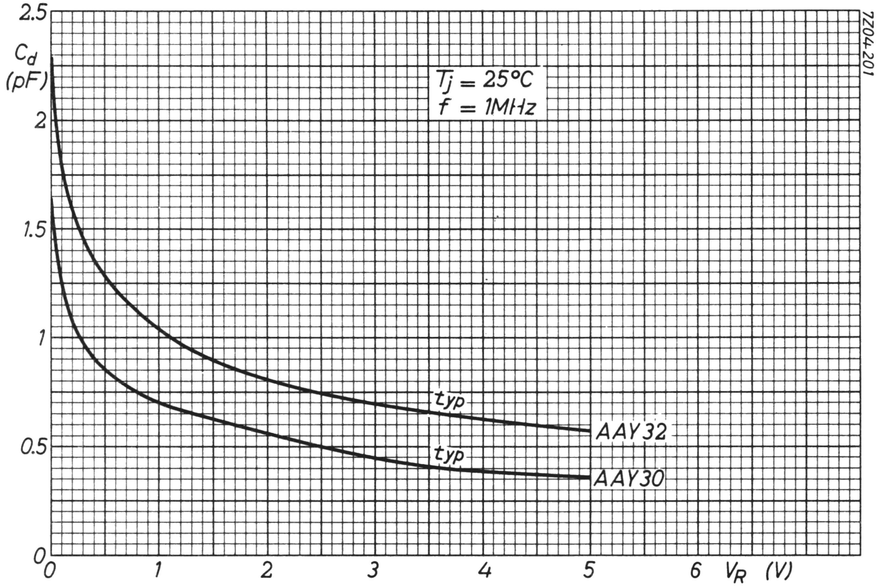

I_R
(μA)
300
200
100
0
0
10
20
30
40
V_R (V)
50
AAY30
7Z04155
$T_j = 25°C$
max

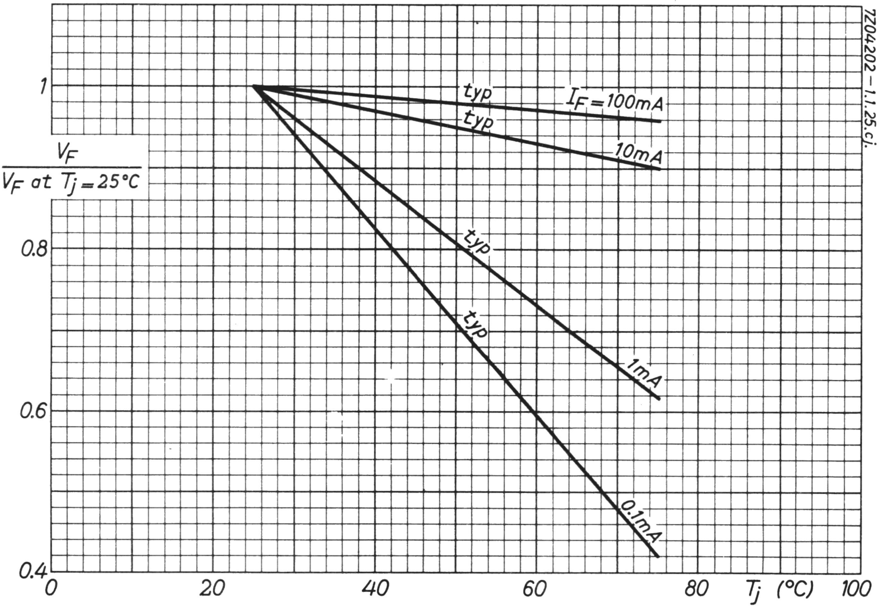

I_R
(μA)
60
40
20
0
0
10
20
30
40
V_R (V)
50
AAY32
7Z04156
$T_j = 25°C$
max

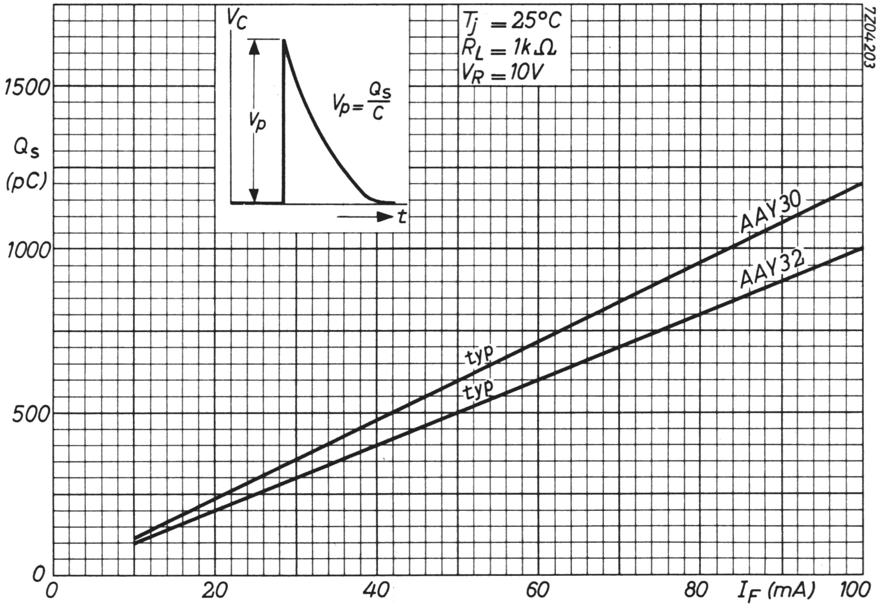

7Z04158
AAY32
I_R (μA)
10^3
5
2
10^2
5
2
10
5
2
1
T_j (°C)
20
40
60
80
max
max
$V_R = 30V$
10V

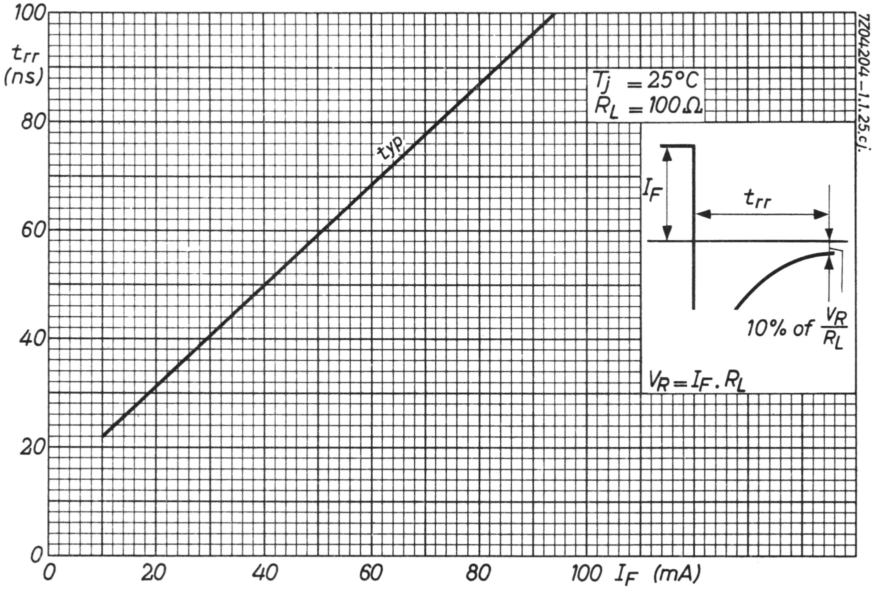

7Z04157
AAY30
I_R (μA)
10^4
5
2
10^3
5
2
10^2
5
2
10
T_j (°C)
20
40
60
80
max
max
$V_R = 50V$
10V

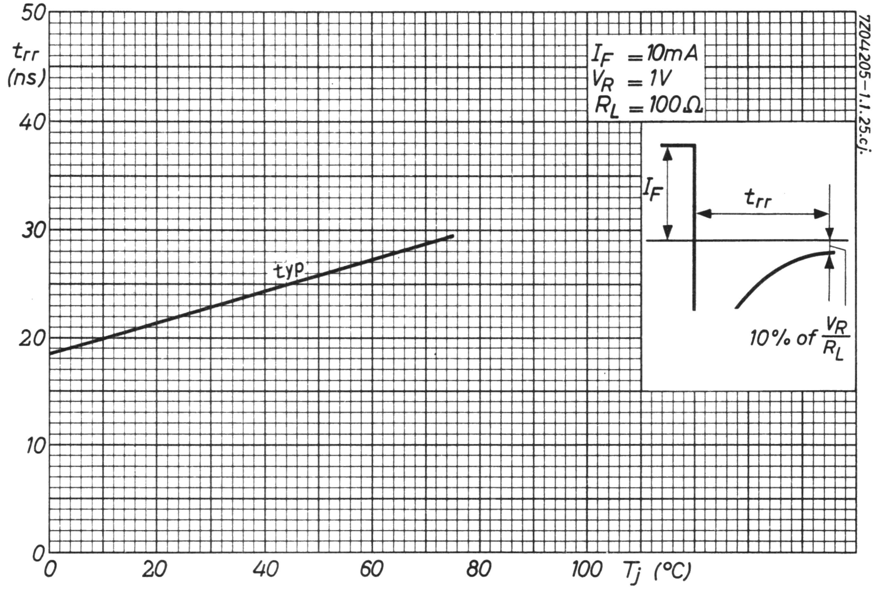

7Z04159
max. voltage
$T_j = 25°C$
I_F (mA)
10^3
2
10^2
5
2
10
5
2
1
5
2
10^{-1}
V_F (V)
0
0.2
0.4
0.6
0.8
1


2.5
C_d
(pF)
2
1.5
1
0.5
0
$T_j = 25°C$
$f = 1MHz$
typ
AAY32
typ
AAY30
0
1
2
3
4
5
6
V_R (V)
7Z04 201


1
$\frac{V_F}{V_F \text{ at } T_j = 25°C}$
0.8
0.6
0.4
typ
I_F = 100mA
typ
10mA
typ
1mA
typ
0.1mA
0
20
40
60
80
T_j (°C)
100
7Z04202 – 1.1.25.c.j.


7Z04203
$T_j = 25°C$
$R_L = 1k\Omega$
$V_R = 10V$
V_C
V_p
$V_p = \frac{Q_s}{C}$
t
AAY30
AAY32
typ
typ
Q_s
(pC)
1500
1000
500
0
0
20
40
60
80
I_F (mA)
100


100
t_{rr}
(ns)
80
60
40
20
0
0
20
40
60
80
100 I_F (mA)
typ
T_j = 25°C
R_L = 100Ω
I_F
t_{rr}
10% of $\frac{V_R}{R_L}$
$V_R = I_F . R_L$
7Z04204–1.1.25.c.i.

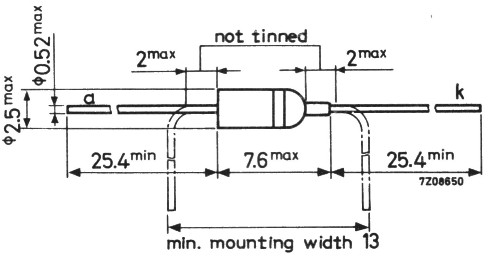

50
t_{rr}
(ns)
40
30
20
10
0
0
20
40
60
80
100 T_j (°C)
typ
I_F = 10mA
V_R = 1V
R_L = 100Ω
I_F
t_{rr}
10% of $\frac{V_R}{R_L}$
7Z04205–1.1.25.c.i.

GOLD BONDED DIODE

Gold bonded germanium diode in subminiature all glass DO-7 envelope, intended for high speed switching applications.

MECHANICAL DATA Dimensions in mm

DO 7


not tinned
2max
2max
ϕ0.52max
ϕ2.5max
a
k
25.4min
7.6max
25.4min
7Z08650
min. mounting width 13

The coloured band indicates the cathode

RATINGS (Limiting values) [1]

Voltage

Continuous reverse voltage	V_R	max.	8	V

Currents

Forward current (d.c. or average over any 50 ms period)	I_F	max.	30	mA
Repetitive peak forward current ($t < 5$ ms)	I_{FRM}	max.	100	mA

Temperatures

Storage temperature	T_{stg}	-55 to	+75	°C
Junction temperature	T_j	max.	75	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.5	°C/mW

---

[1] Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

CHARACTERISTICS T_{amb} = 25 °C unless otherwise specified

Forward voltage

I_F = 1 mA	V_F	typ.	0.27	V
		<	0.32	V
I_F = 10 mA	V_F	typ.	0.50	V
		<	0.60	V
I_F = 30 mA	V_F	typ.	0.60	V
		<	1.00	V

Reverse current

			T_{amb} = 25	60 °C	
V_R = 3 V	I_R	typ.	5	30	µA
		<	25	85	µA
V_R = 8 V	I_R	typ.	30	190	µA
		<	150		µA

Diode capacitance

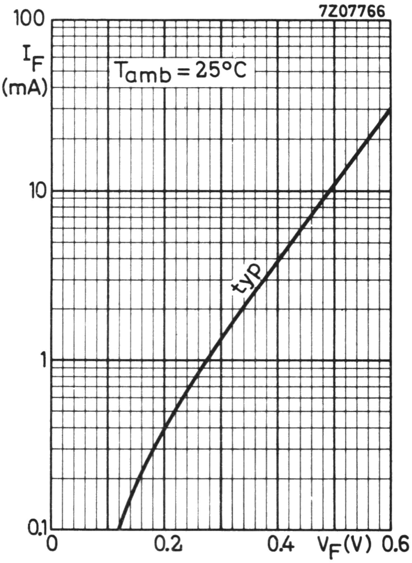
V_R = 1 V	C_d	typ.	3.3	pF
V_R = 3 V	C_d	typ.	1.3	pF
		<	2.0	pF

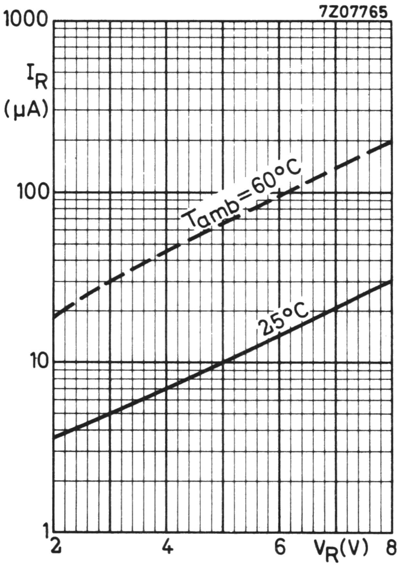
Forward recovery voltage

I_F = 20 mA; t_r = 5 ns	V_{FM}	typ.	0.7	V
		<	1.5	V

Recovered charge when switched from

I_F = 10 mA to V_R = 5 V; R_L = 0.5 kΩ; t_f = 5 ns	Q_s	typ.	20	pC
		<	30	pC





GOLD BONDED DIODES

Gold bonded germanium diodes in subminiature all glass DO-7 envelope, intended for switching applications and general purposes.

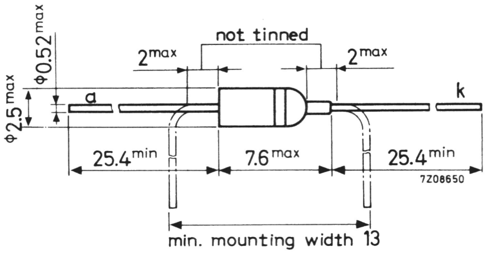
QUICK REFERENCE DATA

			AAZ15	AAZ17	
Continuous reverse voltage	V_R	max.	75	50	V
Repetitive peak reverse voltage	V_{RRM}	max.	100	75	V
Forward current (d.c.)	I_F	max.	140	140	mA
Repetitive peak forward current	I_{FRM}	max.	250	250	mA
Junction temperature	T_j	max.	85	85	°C
Forward voltage at I_F = 250 mA	V_F	<	1.1	1.1	V
Recovered charge when switched from I_F = 10 mA to V_R = 10 V	Q_s	<	1800	900	pC

MECHANICAL DATA

Dimensions in mm

DO-7


φ0.52 max
φ2.5 max
not tinned
2 max
2 max
a
k
25.4 min
7.6 max
25.4 min
7Z08650
min. mounting width 13

The coloured band indicates the cathode

RATINGS (Limiting values) [1]

Voltages

			AAZ15	AAZ17	
Continuous reverse voltage	V_R	max.	75	50	V
Repetitive peak reverse voltage	V_{RRM}	max.	100	75	V
Non repetitive peak reverse voltage ($t < 1$ s)	V_{RSM}	max.	115	75	V

Currents

Forward current (d.c.)	I_F	max.	140	mA
Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	140	mA
Repetitive peak forward current	I_{FRM}	max.	250	mA
Non repetitive peak forward current ($t < 1$ s)	I_{FSM}	max.	500	mA

Temperatures

Storage temperature	T_{stg}		−65 to +85	°C
Junction temperature	T_j	max.	85	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\,j\text{-}a}$	=	0.45	°C/mW

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[1] Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

CHARACTERISTICS

Forward voltage at T_j = 25 °C

I_F = 0.1 mA	$V_F < 0.20$ V
I_F = 10 mA	$V_F < 0.45$ V
I_F = 250 mA	$V_F < 1.10$ V

Forward voltage at T_j = 60 °C

I_F = 0.1 mA	$V_F < 0.15$ V
I_F = 10 mA	$V_F < 0.40$ V
I_F = 250 mA	$V_F < 1.07$ V

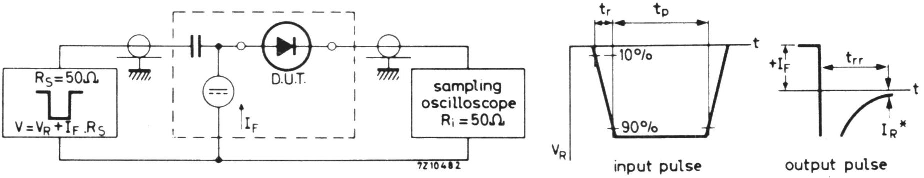
Reverse current at T_j = 25 °C			AAZ15	AAZ17	
V_R = 1.5 V	I_R	<	2.5	2.5	μA
V_R = 10 V	I_R	<	4	15	μA
V_R = 50 V	I_R	<	15	150	μA
V_R = 75 V	I_R	<	25	300	μA
V_R = 100 V	I_R	<	100	–	μA
Reverse current at T_j = 60 °C					
V_R = 1.5 V	I_R	<	30	30	μA
V_R = 10 V	I_R	<	40	60	μA
V_R = 50 V	I_R	<	80	300	μA
V_R = 75 V	I_R	<	120	500	μA
V_R = 100 V	I_R	<	300	–	μA
Diode capacitance					
V_R = 1 V; f = 1 MHz	C_d	<	2	2	pF

CHARACTERISTICS (continued) $T_j = 25\ ^{o}C$

Reverse recovery time when switched
from I_F = 10 mA to V_R = 1 V; R_L = 100 Ω

Measured at I_R = 10 % of $\frac{V_R}{R_L}$	AAZ15	t_{rr}	typ.	350	ns
	AAZ17	t_{rr}	<	350	ns

Test circuit:


$R_S = 50\Omega$
$V = V_R + I_F . R_S$
D.U.T.
I_F
sampling oscilloscope $R_i = 50\Omega$
7Z10482
t_r
t_p
10%
90%
t
V_R
input pulse
$+I_F$
t_{rr}
I_R*
output pulse

*) I_R = 10 % of $\frac{V_R}{R_L}$

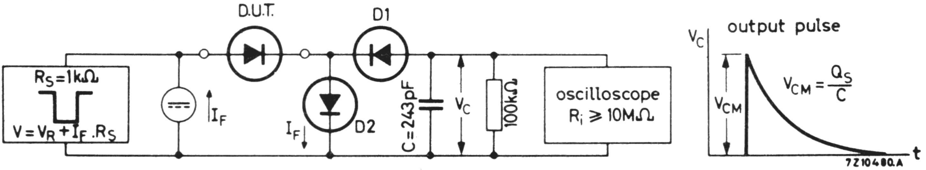
Reverse pulse: Rise time	t_r	=	0.6	ns
Pulse duration	t_p	=	100	ns
Duty cycle	δ	=	0.05	

Circuit capacitance C < 1 pF (C = Oscilloscope + parasitical capacitance)

Recovered charge when switched
from I_F = 10 mA to V_R = 10 V; R_L = 1 kΩ

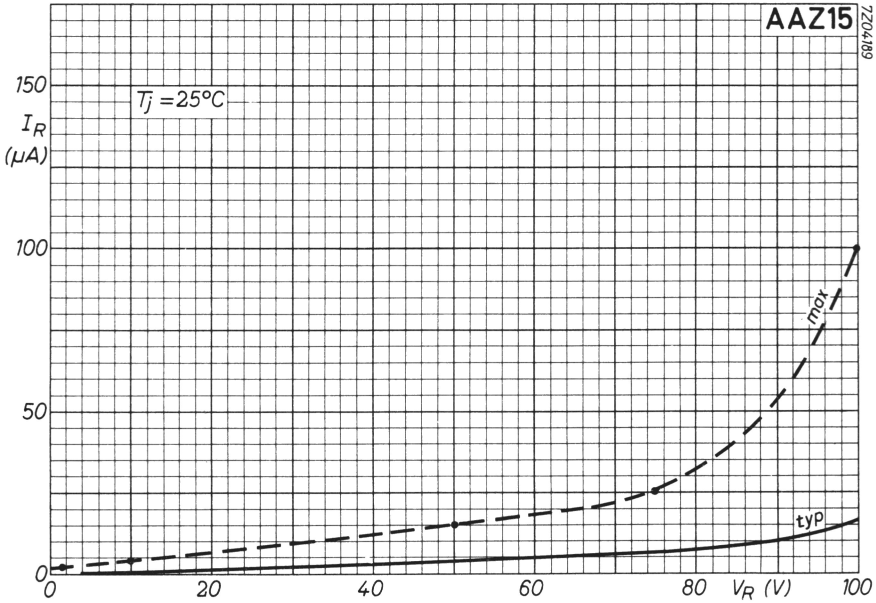
AAZ15	Q_s	<	1800	pC
AAZ17	Q_s	<	900	pC

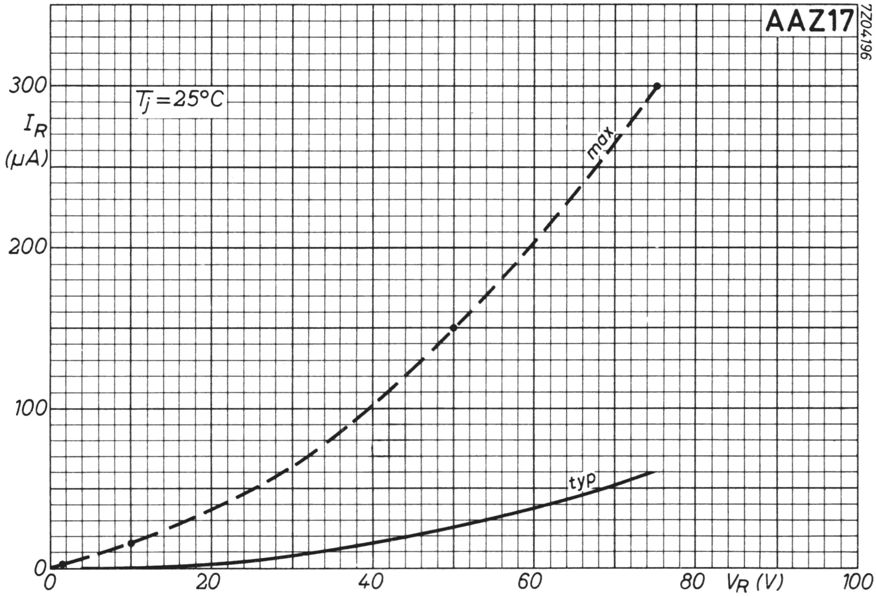
Test circuit:

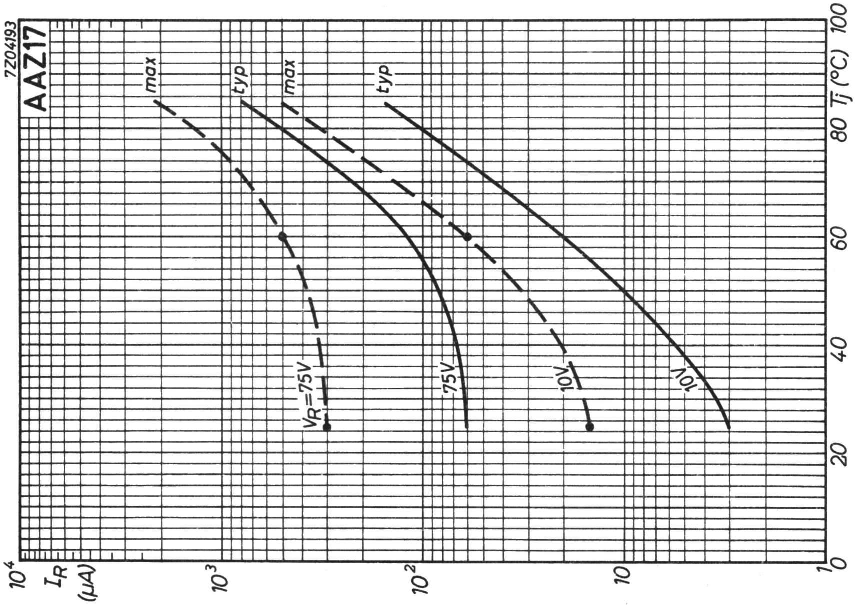

$R_S = 1k\Omega$
$V = V_R + I_F . R_S$
I_F
D.U.T.
D1
I_F
D2
C = 243pF
V_C
100kΩ
oscilloscope $R_i \geqslant 10M\Omega$
V_C
output pulse
V_{CM}
$V_{CM} = \frac{Q_S}{C}$
t
7Z10480A

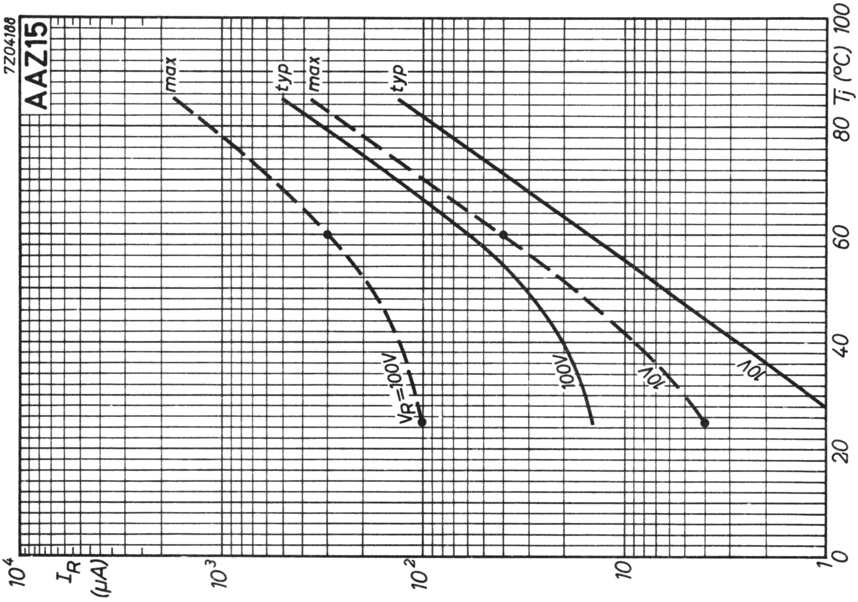
D1 = D2 = BAW62

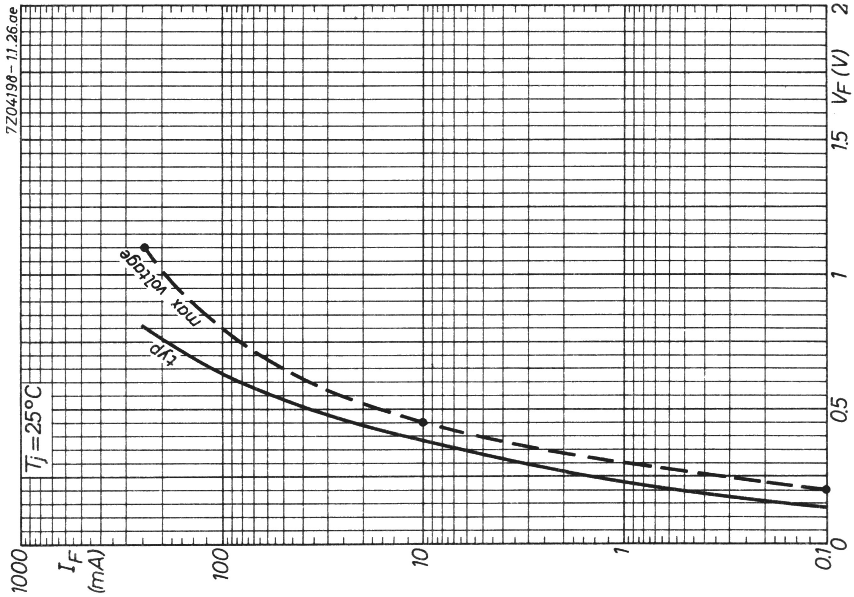
Reverse pulse: Rise time	t_r	=	2	ns
Pulse duration	t_p	=	0.4	μs
Duty cycle	δ	=	0.02	

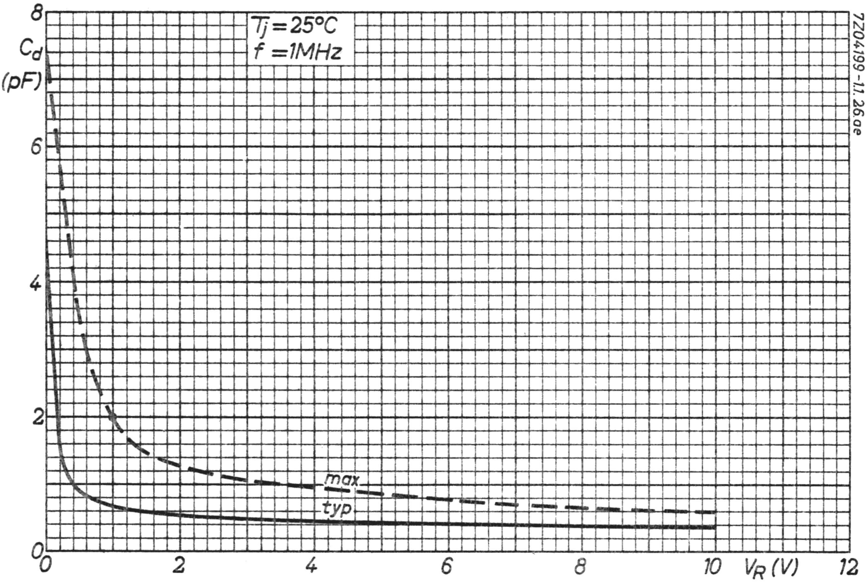

AAZ15
7Z04189
$T_j = 25°C$
I_R
(µA)
150
100
50
0
0
20
40
60
80
V_R (V)
100
max
typ

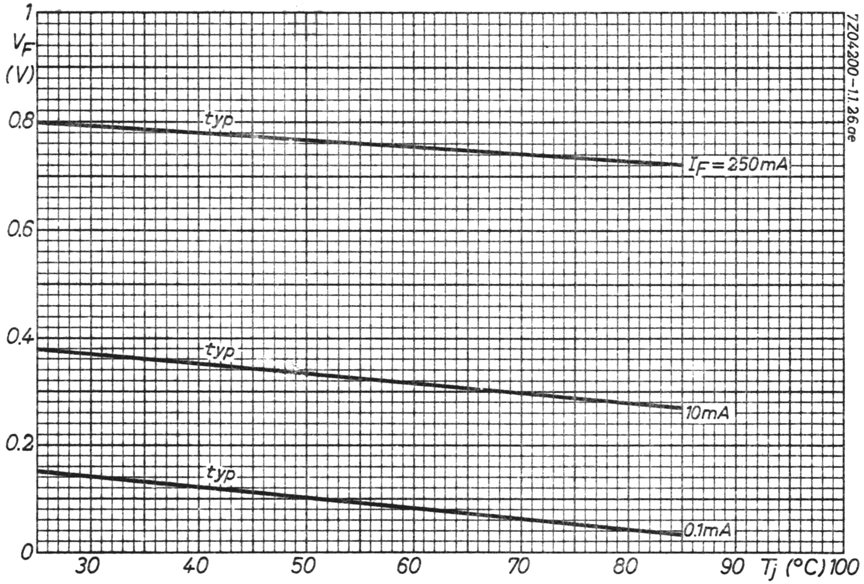

AAZ17
7Z04196
$T_j = 25°C$
I_R
(µA)
300
200
100
0
0
20
40
60
80
V_R (V)
100
max
typ

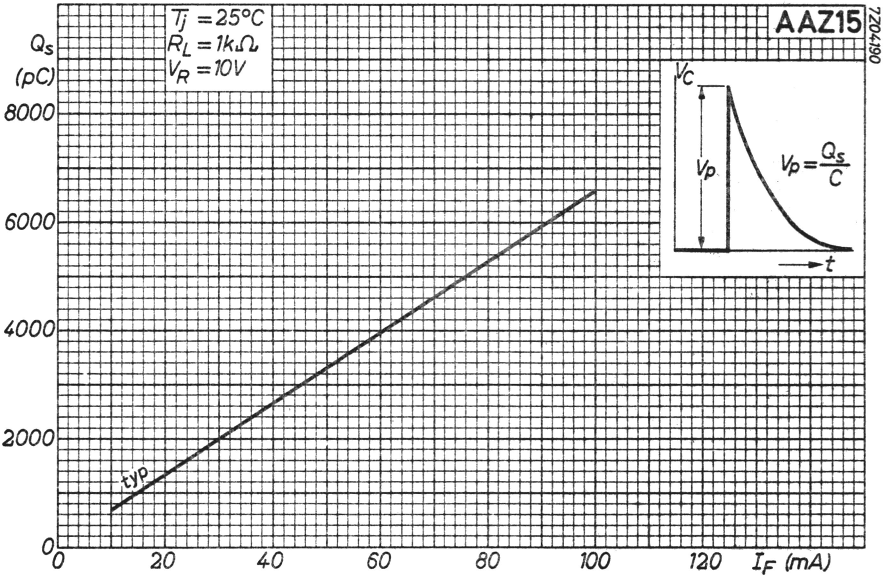

7Z04193
AAZ17
I_R (μA)
10^4
10^3
10^2
10
1
T_j (°C)
0
20
40
60
80
100
max
typ
max
typ
V_R=75V
75V
10V
10V

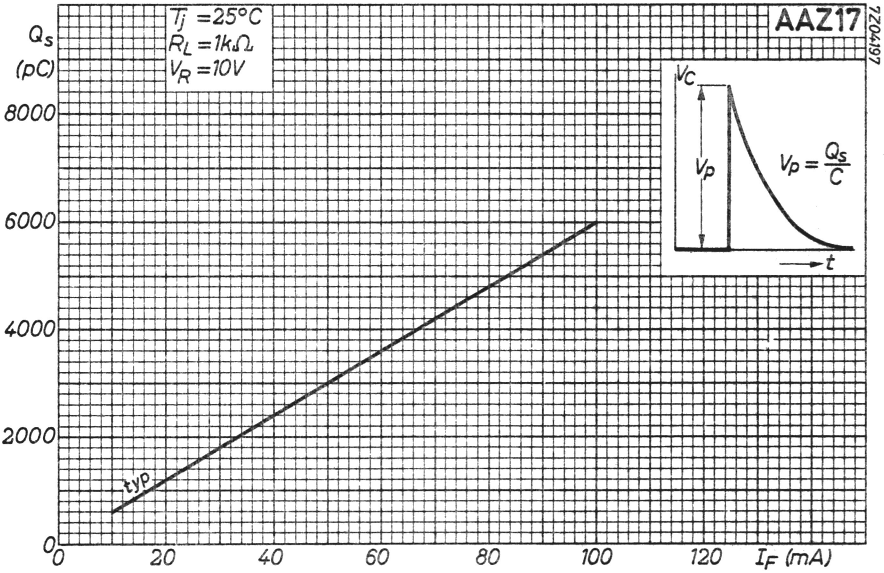

7Z04188
AAZ15
I_R (μA)
10^4
10^3
10^2
10
1
T_j (°C)
0
20
40
60
80
100
max
typ
max
typ
V_R=100V
100V
10V
10V

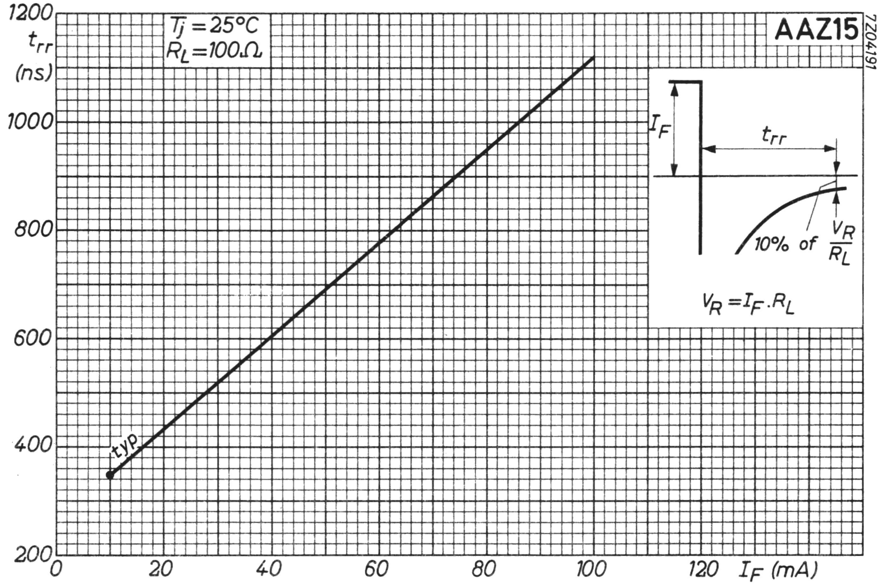

7Z04198-1.1.26.ae
$T_j = 25°C$
I_F (mA)
1000
100
10
1
0.1
V_F (V)
0
0.5
1
1.5
2
max voltage
typ

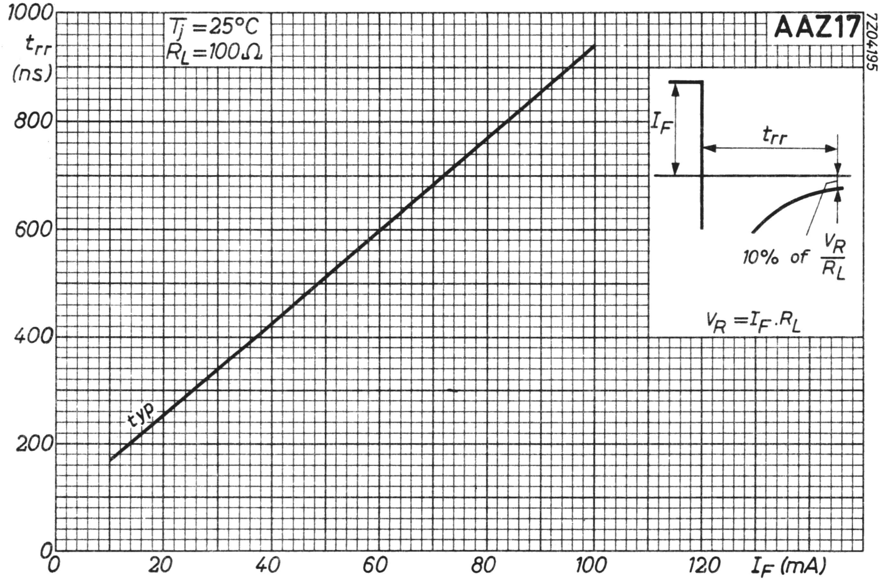

$T_j = 25°C$
$f = 1MHz$
C_d (pF)
0
2
4
6
8
max
typ
0
2
4
6
8
10
V_R (V)
12
7Z04199-1.1.26.ae

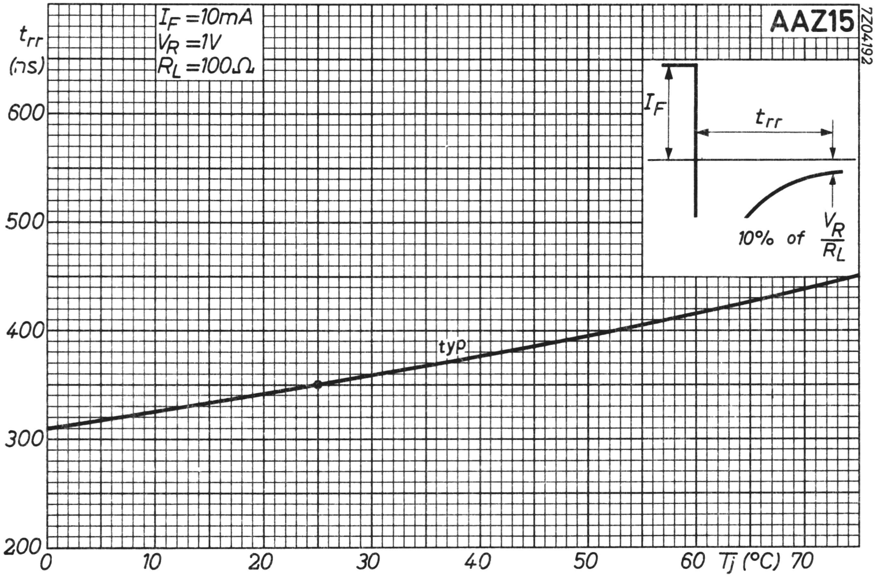

V_F (V)
0
0.2
0.4
0.6
0.8
1
typ
$I_F = 250mA$
typ
10mA
typ
0.1mA
30
40
50
60
70
80
90
T_j (°C)
100
7Z04200-1.1.26.ae

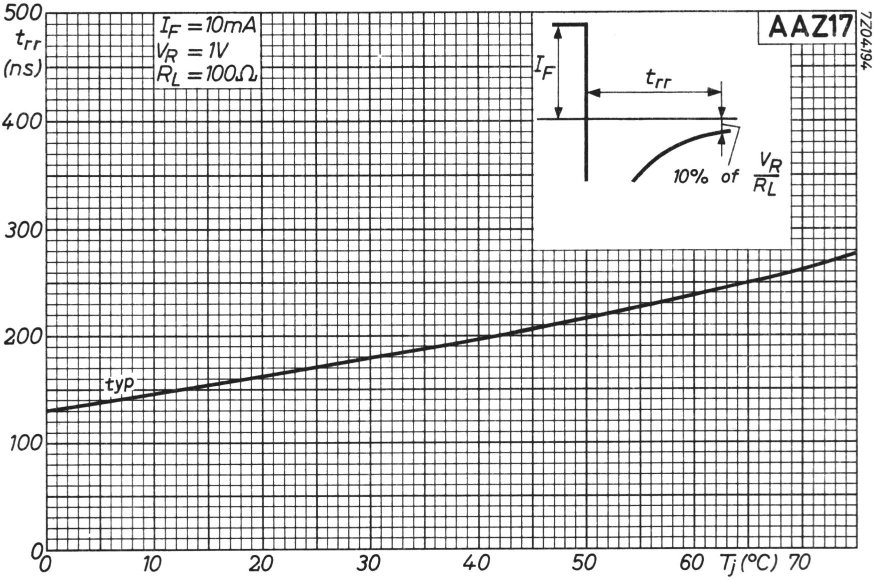

$T_j = 25°C$
$R_L = 1k\Omega$
$V_R = 10V$
AAZ15
7Z04190
Q_s (pC)
8000
6000
4000
2000
0
0
20
40
60
80
100
120
I_F (mA)
typ
V_C
V_p
$V_p = \frac{Q_s}{C}$
t


$T_j = 25°C$
$R_L = 1k\Omega$
$V_R = 10V$
AAZ17
7Z04197
Q_s (pC)
8000
6000
4000
2000
0
0
20
40
60
80
100
120
I_F (mA)
typ
V_C
V_p
$V_p = \frac{Q_s}{C}$
t


1200
t_{rr}
(ns)
1000
800
600
400
200
$T_j = 25°C$
$R_L = 100 \Omega$
AAZ15
7Z04191
typ
I_F
t_{rr}
10% of $\frac{V_R}{R_L}$
$V_R = I_F . R_L$
0
20
40
60
80
100
120
I_F (mA)


1000
t_{rr}
(ns)
800
600
400
200
0
$T_j = 25°C$
$R_L = 100 \Omega$
AAZ17
7Z04195
typ
I_F
t_{rr}
10% of $\frac{V_R}{R_L}$
$V_R = I_F . R_L$
0
20
40
60
80
100
120
I_F (mA)


t_{rr} (ns)
I_F = 10mA
V_R = 1V
R_L = 100Ω
AAZ15
7Z04192
I_F
t_{rr}
10% of $\frac{V_R}{R_L}$
typ
600
500
400
300
200
0
10
20
30
40
50
60
70
T_j (°C)


500
t_{rr} (ns)
I_F = 10mA
V_R = 1V
R_L = 100Ω
AAZ17
7Z04194
I_F
t_{rr}
10% of $\frac{V_R}{R_L}$
typ
400
300
200
100
0
10
20
30
40
50
60
70
T_j (°C)

GOLD BONDED DIODE

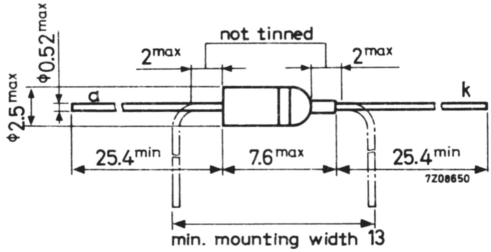
Gold bonded germanium diode in subminiature all glass DO-7 envelope, intended for switching applications and general purposes.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	20	V
Repetitive peak reverse voltage	V_{RRM}	max.	20	V
Forward current (d.c.)	I_F	max.	130	mA
Repetitive peak forward current	I_{FRM}	max.	300	mA
Junction temperature	T_j	max.	75	°C
Forward voltage at I_F = 300 mA	V_F	<	1.0	V

MECHANICAL DATA

Dimensions in mm

DO-7



φ0.52 max
φ2.5 max
2 max
not tinned
2 max
a
k
25.4 min
7.6 max
25.4 min
7Z08650
min. mounting width 13

The coloured band indicates the cathode side

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

Continuous reverse voltage	V_R	max.	20	V
Repetitive peak reverse voltage	V_{RRM}	max.	20	V
Non repetitive peak reverse voltage ($t < 1$ s)	V_{RSM}	max.	30	V

Currents

Forward current (d.c.)	I_F	max.	130	mA
Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	130	mA
Repetitive peak forward current	I_{FRM}	max.	300	mA
Non repetitive peak forward current ($t < 1$ s)	I_{FSM}	max.	400	mA

Temperatures

Storage temperature	T_{stg}		-65 to +75	^{o}C
Junction temperature	T_j	max.	75	^{o}C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\,j\text{-}a}$	=	0.55	^{o}C/mW

CHARACTERISTICS

Forward voltage at $T_j = 25\ ^{o}C$

$I_F = 0.1$ mA	$V_F < 0.20$ V
$I_F = 1.0$ mA	$V_F < 0.30$ V
$I_F = 10$ mA	$V_F < 0.42$ V
$I_F = 30$ mA	$V_F < 0.50$ V
$I_F = 150$ mA [1]	$V_F < 0.75$ V
$I_F = 300$ mA [1]	$V_F < 1.00$ V

Forward voltage at $T_j = 60\ ^{o}C$

$I_F = 0.1$ mA	$V_F < 0.14$ V
$I_F = 1.0$ mA	$V_F < 0.25$ V
$I_F = 10$ mA	$V_F < 0.38$ V
$I_F = 30$ mA	$V_F < 0.48$ V
$I_F = 150$ mA [1]	$V_F < 0.75$ V

Reverse current at $T_j = 25\ ^{o}C$

$V_R = 1.5$ V	$I_R < 3.5$ μA
$V_R = 10$ V	$I_R < 15$ μA
$V_R = 20$ V	$I_R < 50$ μA

Reverse current at $T_j = 60\ ^{o}C$

$V_R = 1.5$ V	$I_R < 30$ μA
$V_R = 10$ V	$I_R < 45$ μA
$V_R = 20$ V	$I_R < 100$ μA

Diode capacitance

$V_R = 1$ V; $f = 1$ MHz	$C_d < 2.5$ pF

---

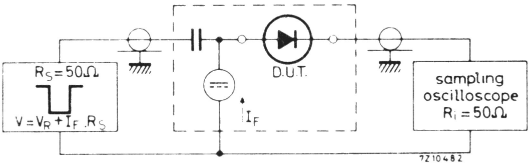
[1] Measured under pulsed conditions to avoid excessive dissipation

CHARACTERISTICS (continued) $T_j = 25\ ^{o}C$

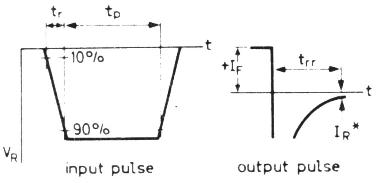
Reverse recovery time when switched
from $I_F = 10$ mA to $V_R = 1$ V; $R_L = 100\ \Omega$ $t_{rr} < 70$ ns

Measured at $I_R = 10\ \%$ of $\frac{V_R}{R_L}$

Test circuit:



$R_S = 50\Omega$
$V = V_R + I_F.R_S$
D.U.T.
I_F
sampling oscilloscope $R_i = 50\Omega$
7Z10482



t_r
t_p
t
10%
90%
V_R
input pulse
$+I_F$
t_{rr}
t
I_R*
output pulse

*) $I_R = 10\ \%$ of $\frac{V_R}{R_L}$

Reverse pulse: Rise time $t_r = 0.6$ ns

Pulse duration $t_p = 100$ ns

Duty cycle $\delta = 0.05$

Circuit capacitance $C < 1$ pF (C = Oscilloscope + parasitical capacitance)

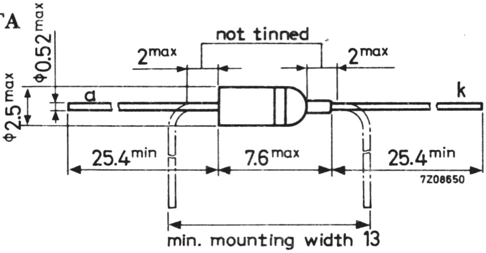
SILICON DIODE

General purpose silicon diode in a subminiature all glass DO-7 envelope.

MECHANICAL DATA

Dimensions in mm

DO-7



The coloured band indicates the cathode

RATINGS (Limiting values) [1]

Voltage				
Continuous reverse voltage	V_R	max.	60	V
Currents				
Forward current (d.c.)	I_F	max.	90	mA
Repetitive peak forward current	I_{FRM}	max.	100	mA
Non repetitive peak forward current ($t \leq 1$ s)	I_{FSM}	max.	200	mA
Temperatures				
Storage temperature	T_{stg}		−55 to +90	°C
Junction temperature	T_j	max.	90	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.4	°C/mW

CHARACTERISTICS

Forward voltage		T_{amb} = 25 °C	T_{amb} = 60 °C	
I_F = 0.1 mA	V_F	typ. 0.55	typ. 0.5	V
		< 0.75		V
I_F = 1.0 mA	V_F	typ. 0.65	typ. 0.6	V
		0.5 to 1.0	0.4 to 0.9	V
I_F = 30 mA	V_F	typ. 0.9	typ. 0.85	V
		< 1.5	< 1.5	V

Reverse current		T_{amb} = 60 °C	T_{amb} = 75 °C	
V_R = 10 V	I_R	typ. 5.0	< 10	μA
V_R = 60 V	I_R	typ. 10	< 20	μA

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[1] Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

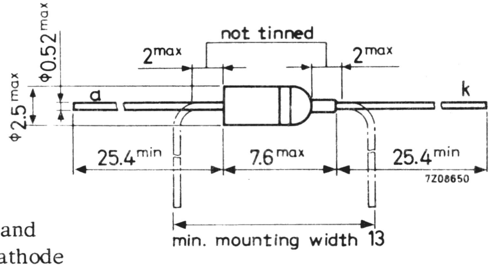
SILICON ALLOYED JUNCTION DIODE

Silicon alloyed junction diode in subminiature all-glass DO-7 envelope intended for use as low voltage stabilizer.

MECHANICAL DATA

Dimensions in mm

DO-7


not tinned
2max
2max
φ0.52 max
φ2.5 max
a
k
25.4min
7.6max
25.4min
7Z08650
min. mounting width 13

The coloured band indicates the cathode

RATINGS (Limiting values) [1]

Current

Forward current (d.c.)	I_F	max.	20	mA

Temperatures

Storage temperature	T_{stg}	-55 to +90	°C
Operating ambient temperature	T_{amb}	-55 to +90	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.4	°C/mW

CHARACTERISTICS

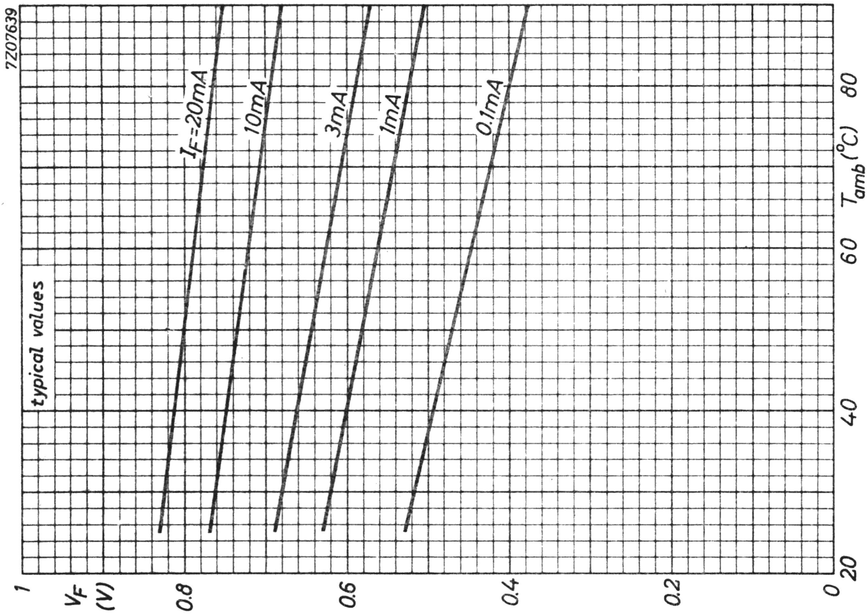
Tamb = 25 °C

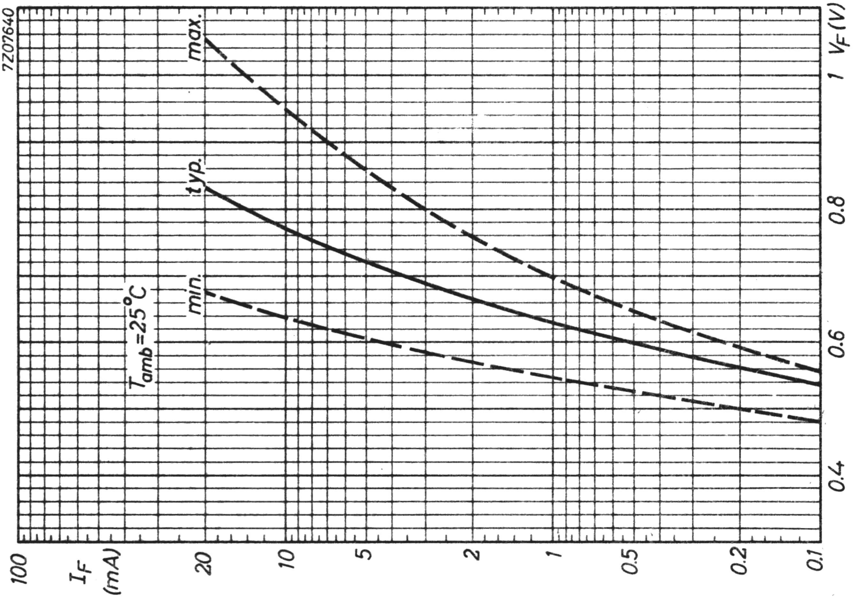
Forward voltage

I_F = 0.2 mA	V_F	>	0.5	V
I_F = 3 mA	V_F	<	0.8	V

---

[1] Limiting values according to the Absolute Maximum System as defined in IEC publication 134.


7Z07639
typical values
I_F=20mA
10mA
3mA
1mA
0.1mA
V_F (V)
1
0.8
0.6
0.4
0.2
0
T_amb (°C)
20
40
60
80


7Z07640
max.
typ.
min.
T_amb=25°C
I_F (mA)
100
20
10
5
2
1
0.5
0.2
0.1
V_F (V)
1
0.8
0.6
0.4

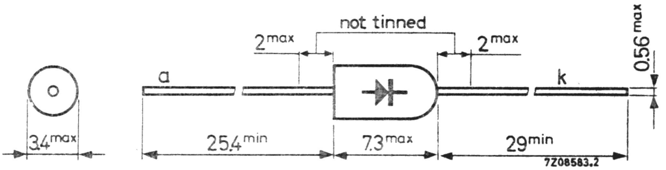
HIGH SPEED SILICON DIODE

Double diffused diode in a DO-14 plastic envelope primarily intended for use in clamp circuits of colour difference amplifiers in television receivers.

QUICK REFERENCE DATA				
Crest working reverse voltage	V_{RWM}	max.	300	V
Repetitive peak reverse voltage	V_{RRM}	max.	350	V
Average forward current with R load $V_{RWM} = V_{RWMmax}$	$I_{F(AV)}$	max.	0.3	A
Non-repetitive peak forward current $t = 10$ ms; $T_j = 125$ °C prior to surge	I_{FSM}	max.	15	A
Junction temperature	T_j	max.	125	°C
Reverse recovery charge when switched from $I_F = 10$ mA to $V_R = 2$ V with $-dI/dt = 5$ mA/µs; $T_j = 25$ °C	Q_s	<	0.4	nC

MECHANICAL DATA Dimensions in mm

DO-14



The sealing of the plastic envelope withstands the accelerated damp heat test of IEC recommendation 68 - 2 (test D, severity IV, 6 cycles).

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

Crest working reverse voltage	V_{RWM}	max.	300	V
Repetitive peak reverse voltage ($\delta \leq 0.01$)	V_{RRM}	max.	350	V
Non-repetitive peak reverse voltage ($t \leq 1$ ms)	V_{RSM}	max.	350	V

Currents

Average forward current (averaged over any 20 ms period) with R load $V_{RWM} = V_{RWMmax}$	$I_{F(AV)}$	max.	0.3	A
Forward current d.c.	I_F	max.	0.3	A
Repetitive peak forward current	I_{FRM}	max.	2	A
Non-repetitive peak forward current ($t = 10$ ms; half sine wave) $T_j = 125\,^{\circ}C$ prior to surge	I_{FSM}	max.	15	A
Repetitive peak reverse current	I_{RRM}	max.	0.5	A

Temperatures

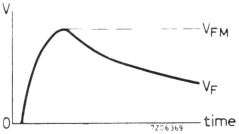
Storage temperature	T_{stg}		-65 to +125	°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

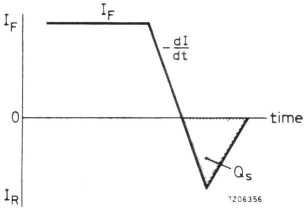
From junction to ambient $R_{th\,j\text{-}a}$ = 0.2 °C/mW

CHARACTERISTICS

Forward voltage I_F = 100 mA; T_j = 75 °C	V_F	<	1.0	V 1)
Peak reverse current V_{RM} = 300 V; T_j = 75 °C	I_{RM}	<	10	µA
Capacitance at f = 1 MHz V_R = 150 V; T_j = 25 to 125 °C	C_d	typ.	4.0	pF
Forward recovery voltage I_F = 100 mA; t_r = 50 ns	V_{FM}	<	3.0	V



Reverse recovery charge when switched from I_F = 10 mA to V_R = 2 V with $-dI/dt$ = 5 mA/µs; T_j = 25 °C	Q_s	<	0.4	nC



SOLDERING AND MOUNTING NOTES

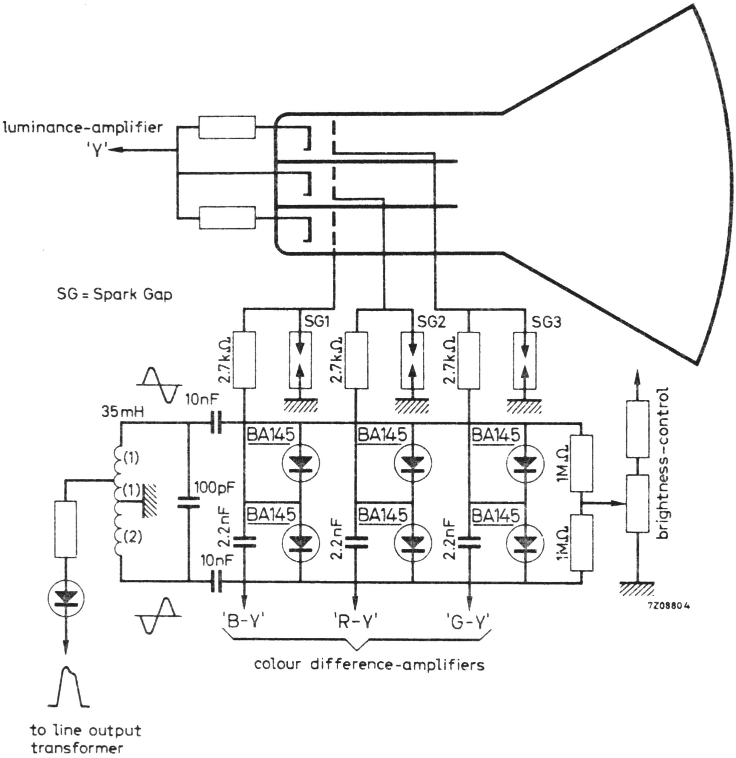
1. Soldered joints must be at least 5 mm from the seal.
2. A soldering iron must not be in contact with the joint for more than 3 seconds.
3. The maximum permissible temperature of the soldering bath is 300 °C; it must not be in contact with the joint for more than 3 seconds.
4. Avoid hot spots due to handling or mounting; the body of the device must not come into contact with or be exposed to a temperature higher than 125 °C.

---

1) Measured under pulsed conditions to avoid excessive dissipation.

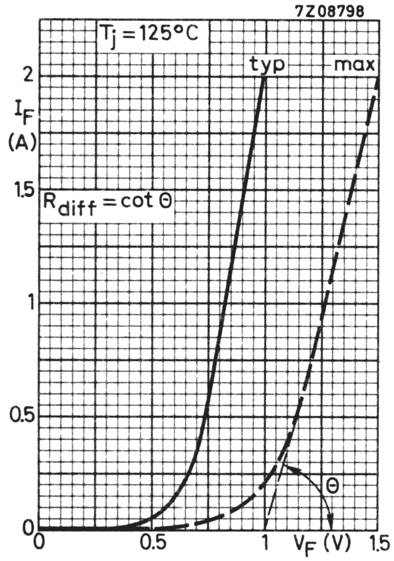
APPLICATION INFORMATION

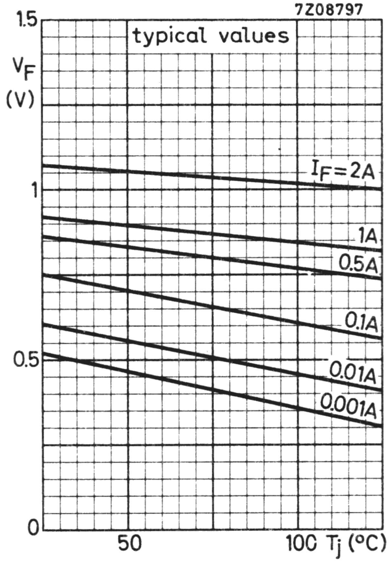
Clamp circuit for colour difference amplifiers in television receivers.

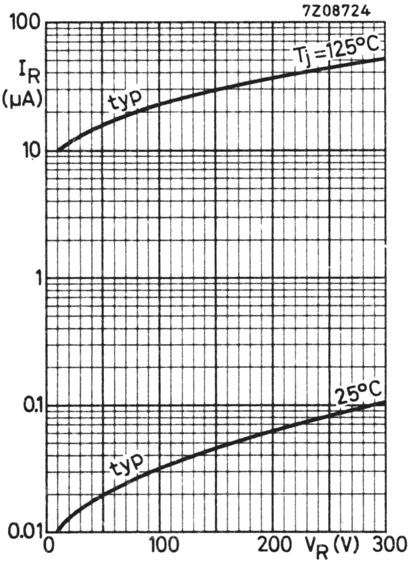

luminance-amplifier
'Y'
SG = Spark Gap
SG1
SG2
SG3
2.7kΩ
2.7kΩ
2.7kΩ
10nF
35mH
(1)
(1)
(2)
100pF
BA145
BA145
BA145
BA145
BA145
BA145
2.2nF
2.2nF
2.2nF
10nF
1MΩ
1MΩ
brightness-control
7Z08804
'B-Y'
'R-Y'
'G-Y'
colour difference-amplifiers
to line output transformer

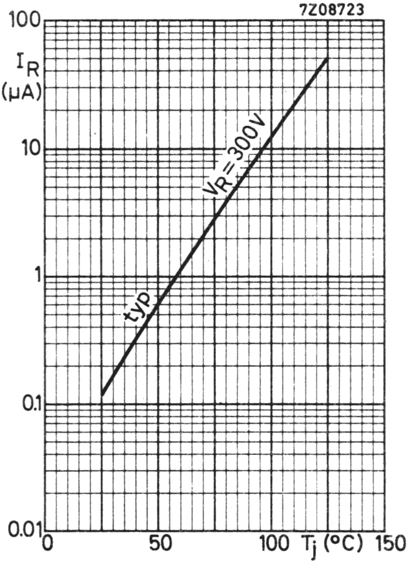
Up to $T_{amb} = 65^{\circ}C$ the differences in clamping levels in the circuit will be less than 1 V.

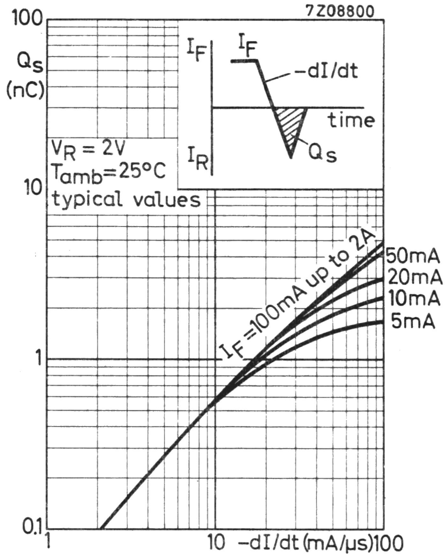
When in a picture tube flash-over occurs, it is possible that high voltage peaks appear at the control grid. These voltage peaks can damage the diodes in the clamp circuit. Protection of the diodes is obtained by means of a sparkgap with breakover voltage of < 3000 V and a resistor of 2.7 kΩ.

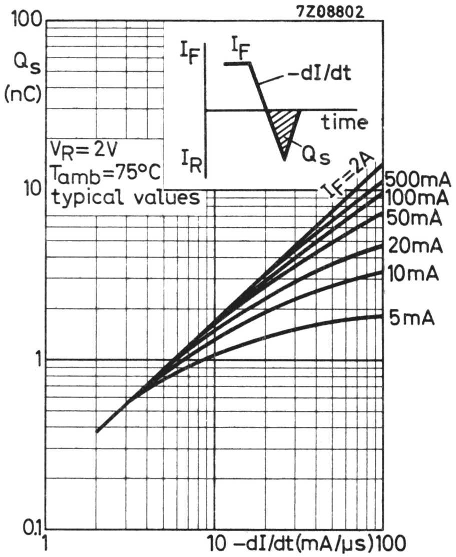

7Z08798
$T_j = 125°C$
typ
max
$R_{diff} = \cot \Theta$
Θ
I_F (A)
2
1.5
1
0.5
0
0
0.5
1
V_F (V)
1.5

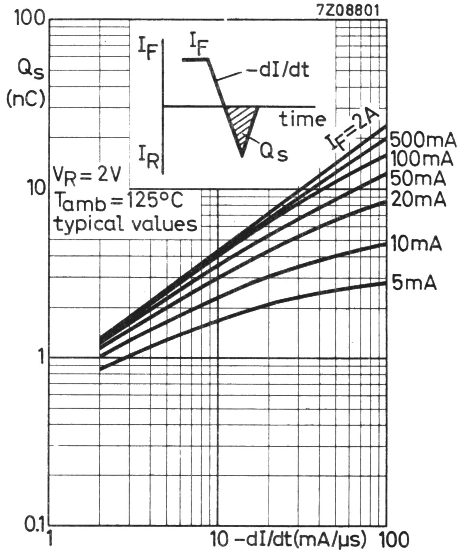

7Z08797
typical values
V_F (V)
1.5
1
0.5
0
I_F = 2A
1A
0.5A
0.1A
0.01A
0.001A
50
100
T_j (°C)

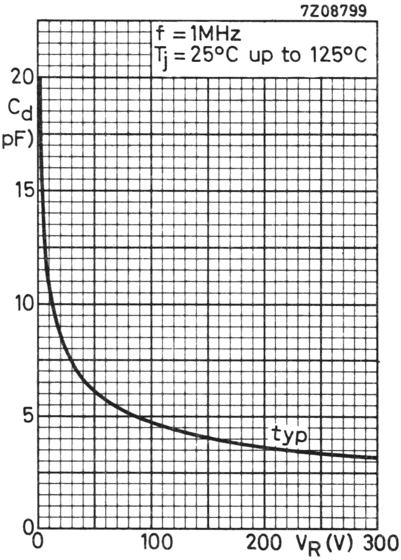

7Z08724
I_R (µA)
100
10
1
0.1
0.01
T_j = 125°C
typ
25°C
typ
0
100
200
V_R (V)
300


7Z08723
I_R (µA)
100
10
1
0.1
0.01
V_R = 300V
typ
0
50
100
T_j (°C)
150


7Z08800
100
Q_s
(nC)
10
1
0.1
1
10
-dI/dt (mA/µs)
100
I_F
I_F
-dI/dt
time
I_R
Q_s
V_R = 2V
T_{amb} = 25°C
typical values
I_F = 100mA up to 2A
50mA
20mA
10mA
5mA


7Z08802
100
Q_s
(nC)
10
1
0.1
1
10
-dI/dt (mA/µs)
100
I_F
I_F
-dI/dt
time
I_R
Q_s
V_R = 2V
T_{amb} = 75°C
typical values
I_F = 2A
500mA
100mA
50mA
20mA
10mA
5mA


7Z08801
100
Q_s
(nC)
10
1
0.1
1
10
-dI/dt (mA/µs)
100
I_F
I_F
-dI/dt
time
I_R
Q_s
V_R = 2V
T_{amb} = 125°C
typical values
I_F = 2A
500mA
100mA
50mA
20mA
10mA
5mA


7Z08799
f = 1MHz
T_j = 25°C up to 125°C
20
C_d
(pF)
15
10
5
0
0
100
200
V_R (V)
300
typ

FAST RECOVERY SILICON DIODE

Double diffused general purpose diode in a DO-14 plastic envelope for use as line phase detector, scan rectifier for the supply of the small signal parts in television receivers and other h.f. power supplies.

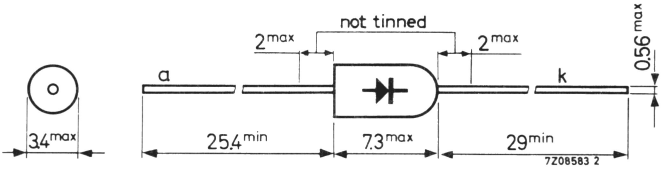
QUICK REFERENCE DATA

Crest working reverse voltage	V_{RWM}	max.	300	V
Repetitive peak reverse voltage	V_{RRM}	max.	350	V
Average forward current with R load				
$V_{RWM} = V_{RWMmax}$	$I_{F(AV)}$	max.	0.4	A
$V_{RWM} = 80$ V	$I_{F(AV)}$	max.	0.5	A
Non-repetitive peak forward current $t = 10$ ms; $T_j = 125\,^{o}$C prior to surge	I_{FSM}	max.	15	A
Junction temperature	T_j	max.	150	^{o}C
Reverse recovery charge when switched from $I_F = 10$ mA to $V_R = 2$ V with $-dI/dt = 5$ mA/µs; $T_j = 25\,^{o}$C	Q_s	<	0.8	nC

MECHANICAL DATA

Dimensions in mm

DO-14



The sealing of the plastic envelope withstands the accelerated damp heat test of IEC recommendation 68 - 2 (test D, severity IV, 6 cycles).

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

Crest working reverse voltage	V_{RWM}	max.	300	V
Repetitive peak reverse voltage ($\delta \leq 0.01$)	V_{RRM}	max.	350	V
Non-repetitive peak reverse voltage ($t \leq 10\,ms$)	V_{RSM}	max.	350	V

Currents

Average forward current (averaged over any 20 ms period) with R load $V_{RWM} = V_{RWMmax}$	$I_{F(AV)}$	max.	0.4	A
$V_{RWM} = 80\,V$	$I_{F(AV)}$	max.	0.5	A
Repetitive peak forward current	I_{FRM}	max.	3.0	A
Repetitive peak forward current ($\delta \leq 0.03$; $f \geq 15$ kHz)	I_{FRM}	max.	5.0	A
Non-repetitive peak forward current ($t = 10\,ms$; half sine wave) $T_j = 125\,^oC$ prior to surge	I_{FSM}	max.	15	A
Repetitive peak reverse current	I_{RRM}	max.	0.5	A

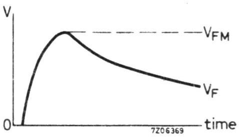
Temperatures

Storage temperature	T_{stg}	−65 to +125	^oC
Junction temperature	T_j	max. 150	^oC

THERMAL RESISTANCE See page 3

CHARACTERISTICS

Forward voltage $I_F = 2\,A$; $T_j = 150\,^oC$	V_F	<	1.5	V 1)
Peak reverse current $V_{RM} = 300\,V$; $T_j = 125\,^oC$	I_{RM}	<	200	µA
Capacitance at f = 1 MHz $V_R = 150\,V$; $T_j = 25$ to $125\,^oC$	C_d	typ.	4.0	pF
Forward recovery voltage $I_F = 100\,mA$; $t_r = 50\,ns$	V_{FM}	<	3.0	V



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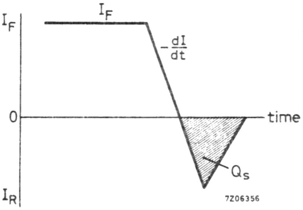
1) Measured under pulsed conditions to avoid excessive dissipation.

CHARACTERISTICS (continued)

Reverse recovery charge when switched from.

I_F = 10 mA to V_R = 2 V with
$-\frac{dI}{dt}$ = 5 mA/μs; T_j = 25 °C

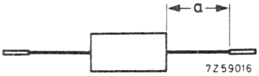
Q_s	<	0.8	nC



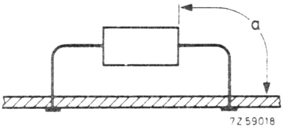
THERMAL RESISTANCE

Effect of mounting on thermal resistance $R_{th\ j-a}$

The quoted values apply when no other leads run to the tie-points. If leads of other dissipating components share the same tie-points, the thermal resistance will be higher than that quoted.

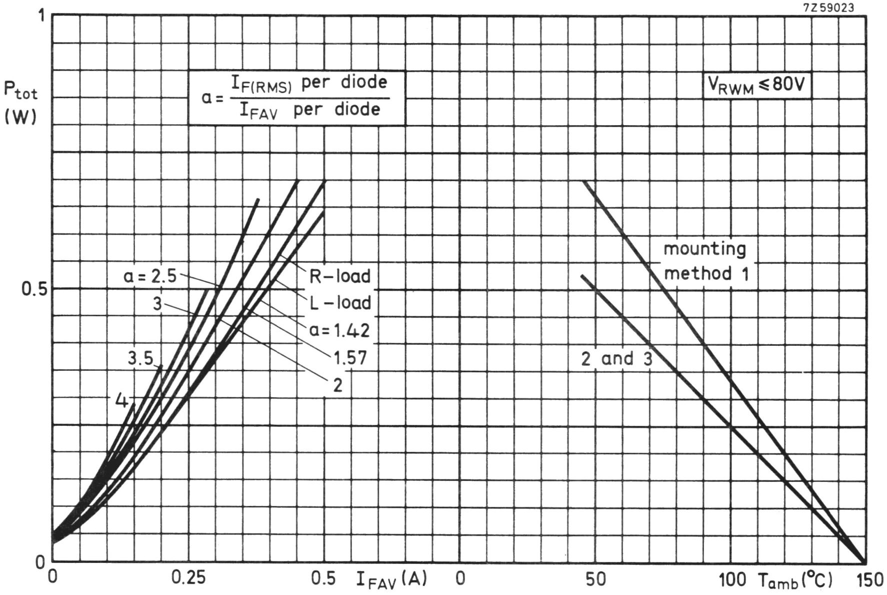


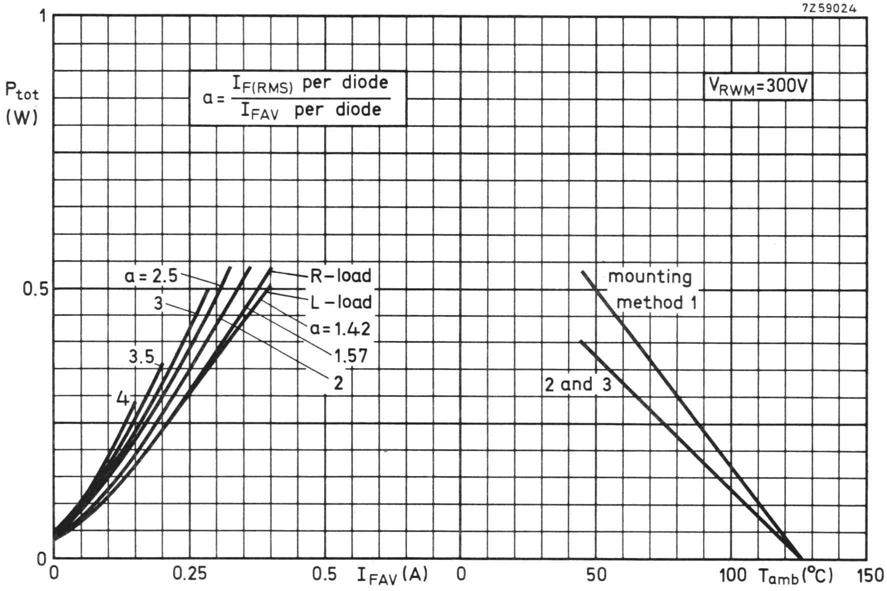
1. Mounted to solder tags at a lead-length a = 10 mm. $R_{th\ j-a}$ = 150 °C/W
2. Mounted to solder tags at a = maximum lead-length. $R_{th\ j-a}$ = 200 °C/W
3. Mounted on printed-wiring board with a small area of copper at a lead-length a > 5 mm.
   $R_{th\ j-a}$ = 200 °C/W



SOLDERING AND MOUNTING NOTES

1. Soldered joints must be at least 5 mm from the seal.
2. The maximum permissible temperature of the soldering iron or bath is 300 °C; it must be in contact with the joint for no more than 3 seconds.
3. Avoid hot spots due to handling or mounting; the body of the device must not come into contact with or be exposed to a temperature higher than 125°C.


7Z59023
P_tot (W)
1
0.5
0
a = I_F(RMS) per diode / I_FAV per diode
V_RWM ≤ 80V
a = 2.5
3
3.5
4
R-load
L-load
a = 1.42
1.57
2
mounting method 1
2 and 3
0
0.25
0.5
I_FAV (A)
0
50
100
T_amb (°C)
150

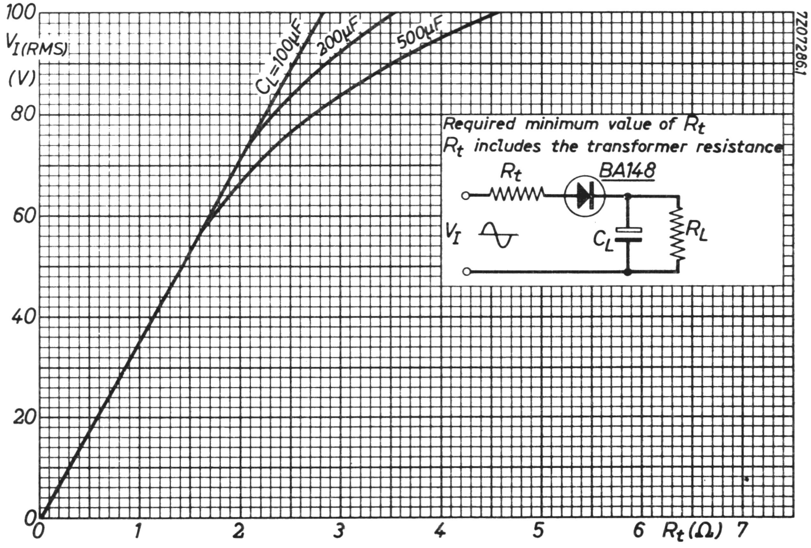

7Z59024
P_tot (W)
1
0.5
0
a = I_F(RMS) per diode / I_FAV per diode
V_RWM = 300V
a = 2.5
3
3.5
4
R-load
L-load
a = 1.42
1.57
2
mounting method 1
2 and 3
0
0.25
0.5
I_FAV (A)
0
50
100
T_amb (°C)
150

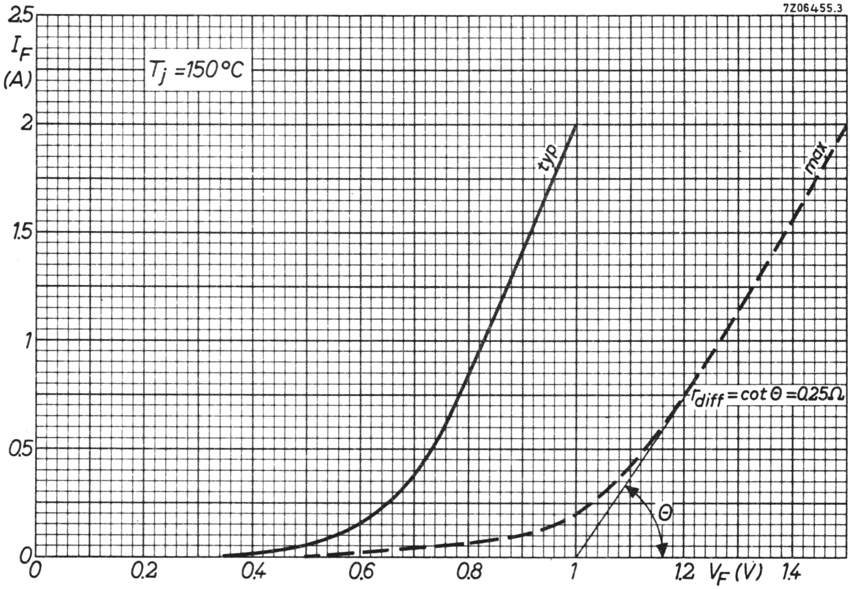
From the left hand graph the total power dissipation can be found as a function of the forward current.

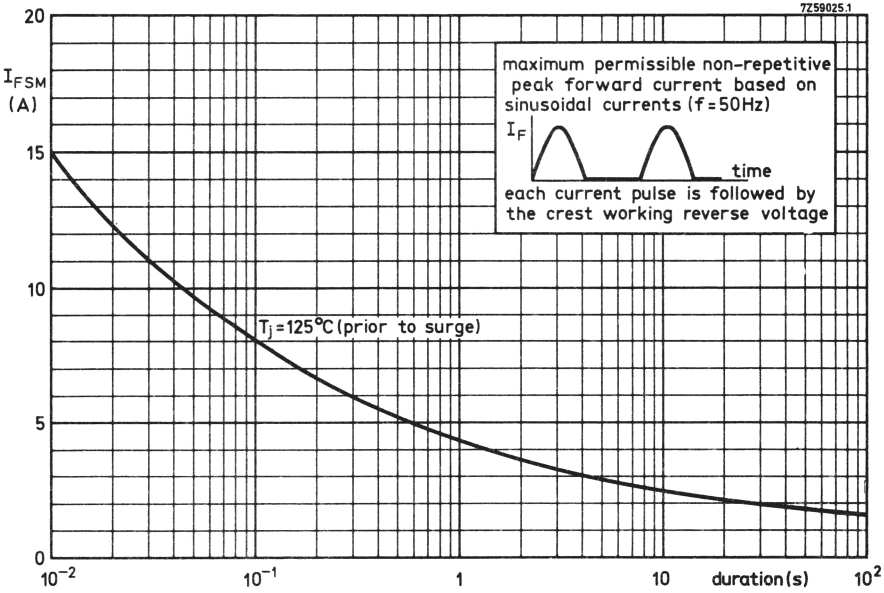
The parameter $a = \dfrac{I_{F(RMS)} \text{ per diode}}{I_{FAV} \text{ per diode}}$ depends on $\omega R_L C_L$ and $\dfrac{R_t + \text{rdiff.}}{R_L}$ and can be found from existing graphs.

See Application Book: RECTIFIER DIODES
Once the power dissipation is known, the max. permissible ambient temperature follows from the right hand graph.

For the series resistance, added to limit the initial peak rectifier current, the required minimum value can be found from the graph below.
rdiff. is shown on page 6, upper figure.

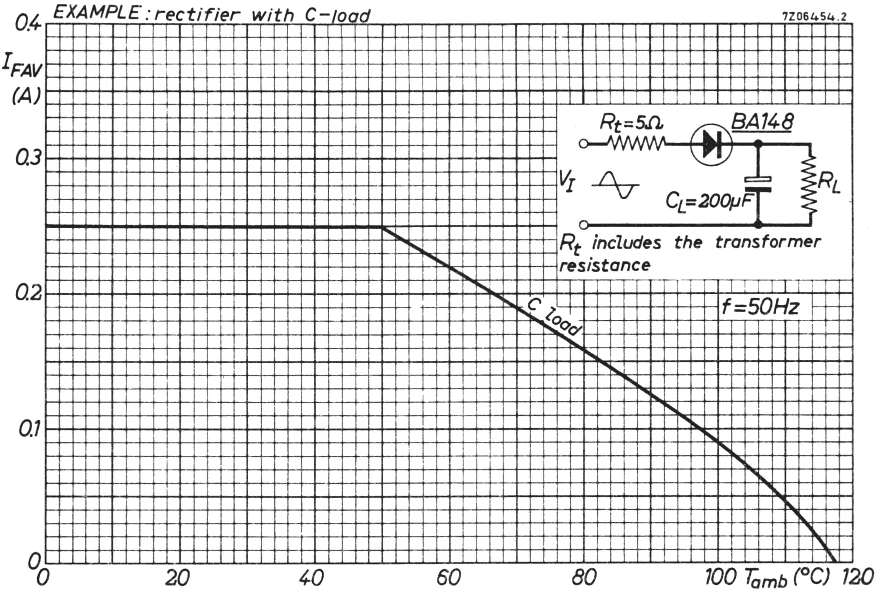


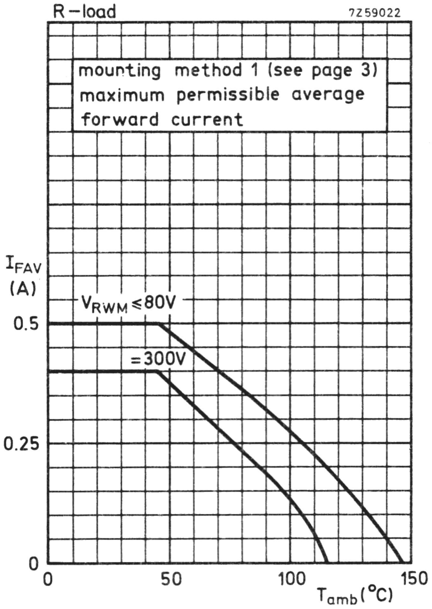


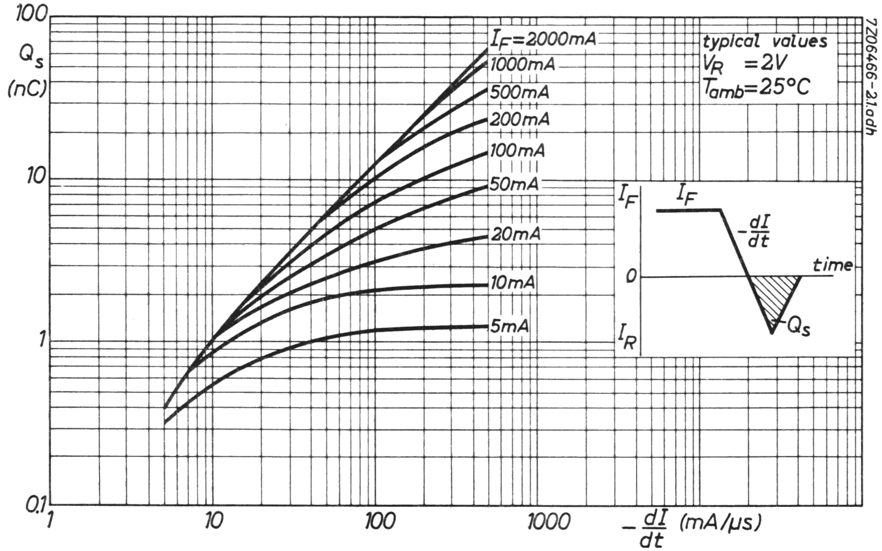


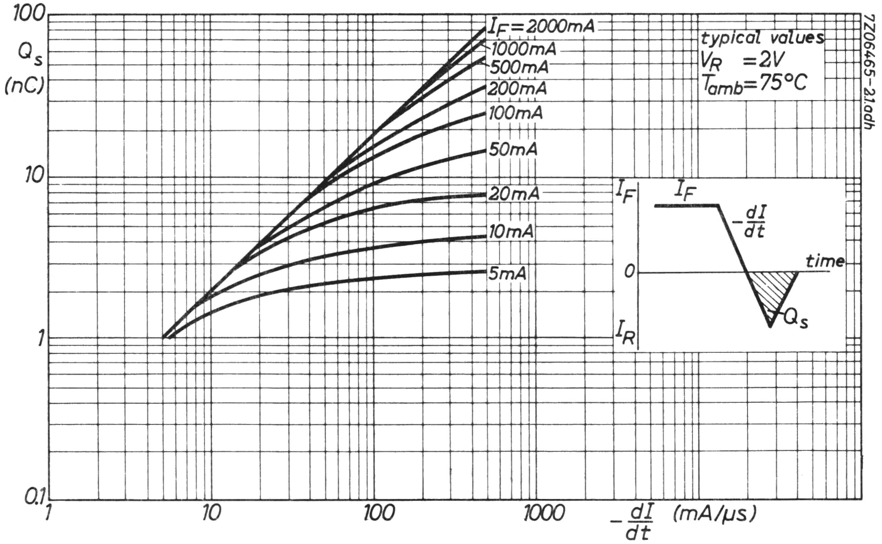
maximum permissible non-repetitive peak forward current based on sinusoidal currents (f = 50Hz)

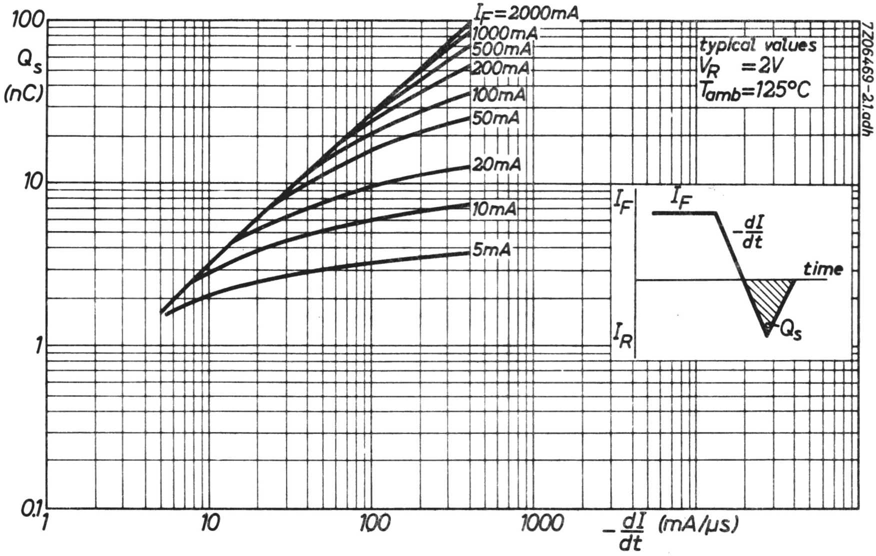
each current pulse is followed by the crest working reverse voltage

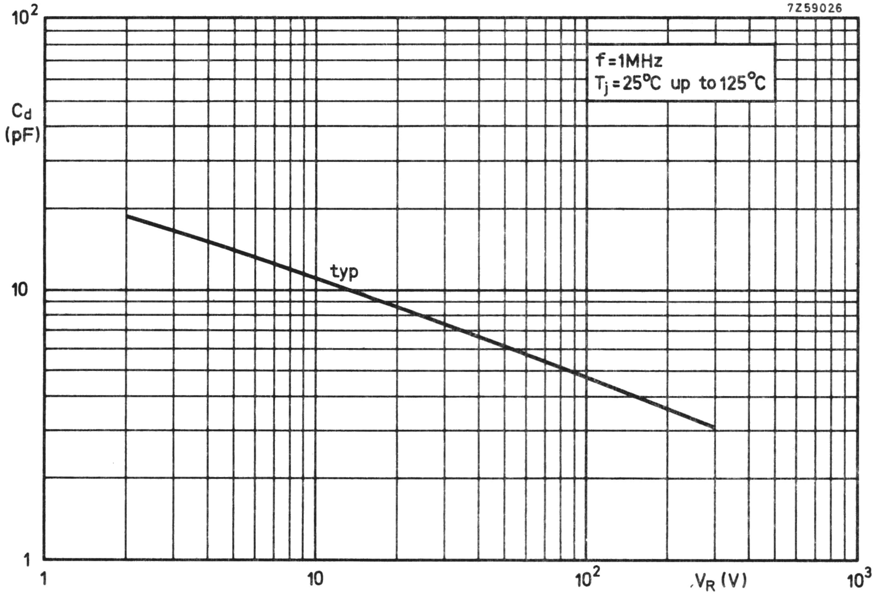

EXAMPLE : rectifier with C-load
7Z06454.2
I_{FAV} (A)
0.4
0.3
0.2
0.1
0
$R_t = 5\Omega$
BA148
V_I
$C_L = 200\mu F$
R_L
R_t includes the transformer resistance
f = 50Hz
C load
0
20
40
60
80
100
T_{amb} (°C)
120


R – load
7Z59022
mounting method 1 (see page 3)
maximum permissible average
forward current
I_{FAV} (A)
$V_{RWM} \leq 80V$
= 300V
0.5
0.25
0
0
50
100
150
T_{amb} (°C)


100
Q_s
(nC)
10
1
0.1
1
10
100
1000
$-\frac{dI}{dt}$ (mA/μs)
I_F=2000mA
1000mA
500mA
200mA
100mA
50mA
20mA
10mA
5mA
typical values
V_R =2V
T_{amb}=25°C
I_F
I_F
$-\frac{dI}{dt}$
0
time
I_R
Q_s
7Z06466-2.1.adh

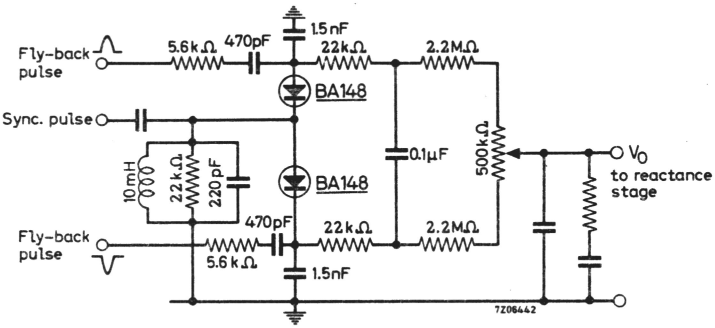

100
Q_s
(nC)
10
1
0.1
1
10
100
1000
$-\frac{dI}{dt}$ (mA/μs)
I_F=2000mA
1000mA
500mA
200mA
100mA
50mA
20mA
10mA
5mA
typical values
V_R =2V
T_{amb}=75°C
I_F
I_F
$-\frac{dI}{dt}$
0
time
I_R
Q_s
7Z06465-2.1.adh


7Z06469-2.1.adh
Q_s (nC)
100
10
1
0.1
1
10
100
1000
$-\frac{dI}{dt}$ (mA/μs)
I_F=2000mA
1000mA
500mA
200mA
100mA
50mA
20mA
10mA
5mA
typical values
V_R =2V
T_{amb}=125°C
I_F
I_F
$-\frac{dI}{dt}$
time
I_R
Q_s


7Z59026
C_d (pF)
10^2
10
1
1
10
10^2
V_R (V)
10^3
f=1MHz
T_j=25°C up to 125°C
typ

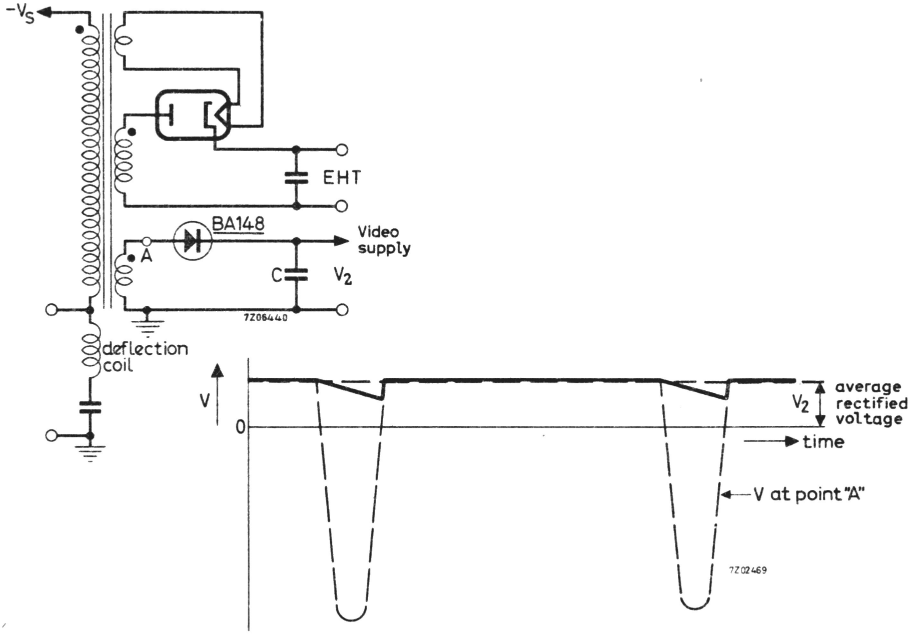
APPLICATION INFORMATION

Self catching line phase detector


Fly-back pulse
5.6kΩ
470pF
1.5nF
22kΩ
2.2MΩ
BA148
Sync. pulse
10mH
22kΩ
220pF
0.1μF
500kΩ
BA148
V_O
to reactance stage
Fly-back pulse
470pF
5.6kΩ
22kΩ
2.2MΩ
1.5nF
7Z06442

The high speed and low leakage current of the BA148 make it particularly useful in the type of line phase detector shown above.

Low voltage supply from the line output stage of a television receiver.


$-V_S$
EHT
BA148
Video supply
A
C
V_2
7Z06440
deflection coil
V
0
V_2
average rectified voltage
time
V at point "A"
7Z02469

An extra winding on the line output transformer in series with a BA148 can supply up to 30 V for the low voltage parts of a television receiver. Because the diode conducts during scan the source impedance is low and the output voltage stable.

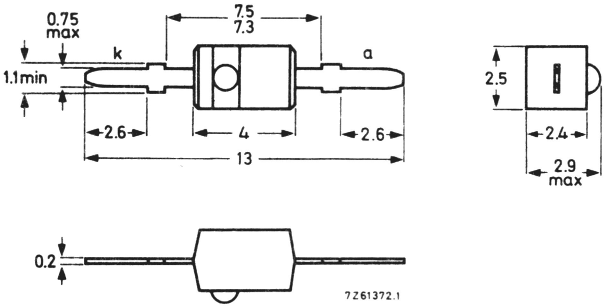
SILICON PLANAR DIODE

The BA182 is a switching diode in a plastic envelope. It is intended for band switching in v.h.f. television tuners.

QUICK REFERENCE DATA

Continuous reverse voltage	V_R	max.	35	V
Forward current (d.c.)	I_F	max.	100	mA
Junction temperature	T_j	max.	100	°C
Diode capacitance at f = 1 MHz V_R = 20 V	C_d	typ. <	0.8 1	pF pF
Series resistance at f = 200 MHz I_F = 5 mA	r_D	typ. <	0.5 0.7	Ω Ω

MECHANICAL DATA Dimensions in mm



The white band indicates the cathode

The sealing of the plastic envelope withstands the accelerated damp heat test of IEC recommendation 68-2 (test D, severity IV, 6 cycles)

RATINGS (Limiting values) [1]

Voltage				
Continuous reverse voltage	V_R	max.	35	V
Current				
Forward current (d.c.)	I_F	max.	100	mA
Temperatures				
Storage temperature	T_{stg}	-55 to +100		°C
Junction temperature	T_j	max.	100	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.4	°C/mW

CHARACTERISTICS

Forward voltage at I_F = 100 mA	V_F	<	1.2	V
Reverse current				
V_R = 20 V	I_R	<	100	nA
V_R = 20 V; T_j = 60 °C	I_R	<	1	μA
Diode capacitance at f = 1 MHz				
V_R = 20 V	C_d	typ. <	0.8 1	pF pF
Series resistance at f = 200 MHz				
I_F = 5 mA	r_D	typ. <	0.5 0.7	Ω Ω

MOUNTING AND SOLDERING INSTRUCTIONS

Mounting

The leads must be bent with a radius of not less than 0.5 mm near the seal. (This can be done by hand if care is taken to exert no pulling force).

Soldering

At a maximum iron or solder temperature of 300 °C, the maximum permissible soldering time is 3 seconds. The soldering spot may be at any distance from the seal. During soldering, care must be taken that the plastic body does not come into contact with any temperature higher than 125 °C.

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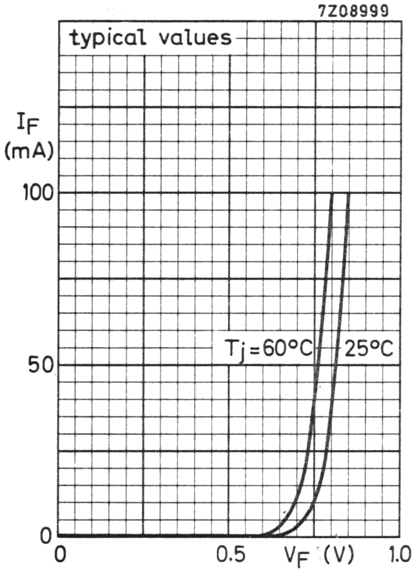
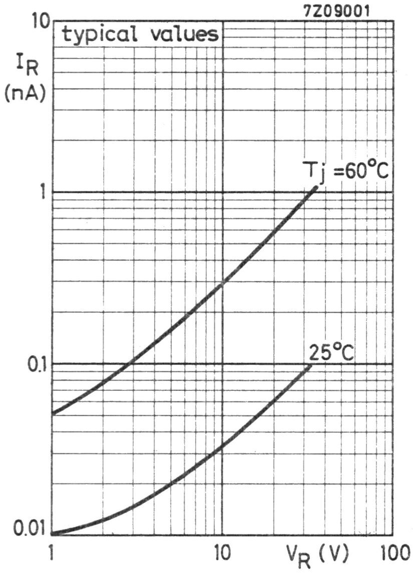
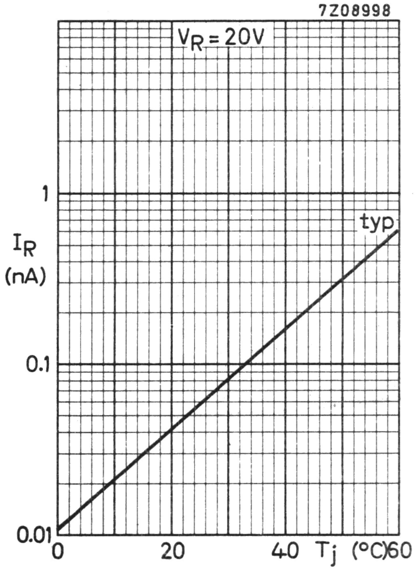
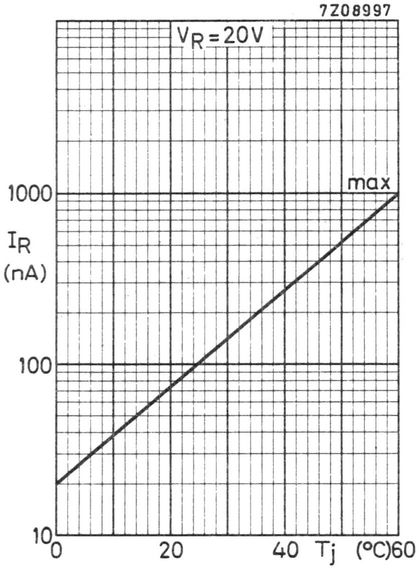
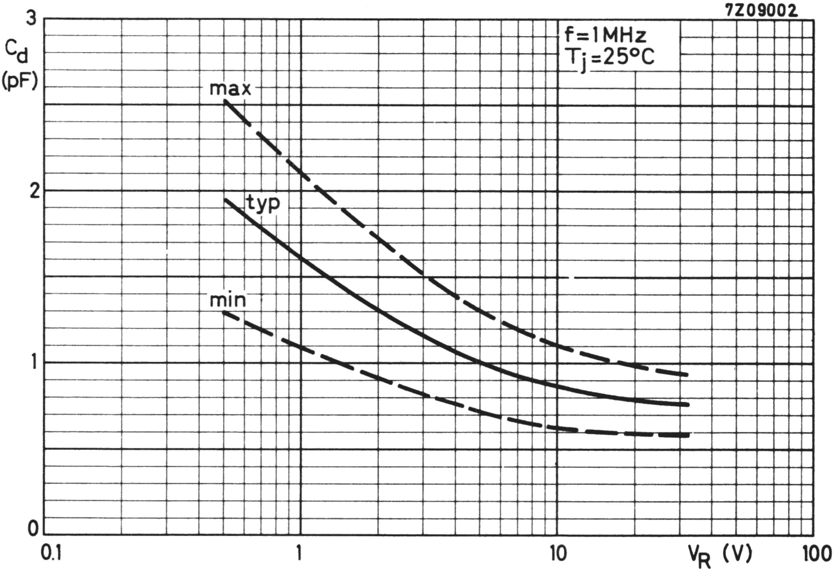
[1] Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

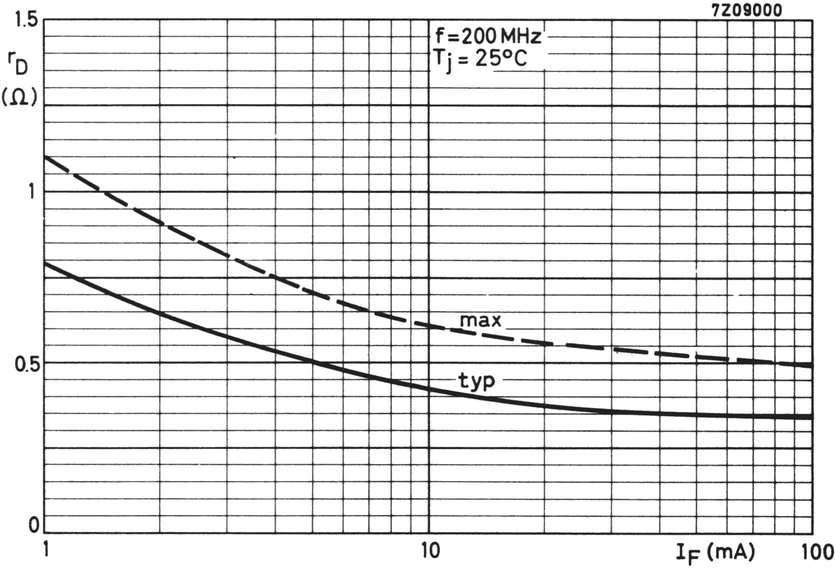

7Z08999
typical values
I_F (mA)
100
50
0
$T_j = 60°C$
25°C
0
0.5
V_F (V)
1.0


7Z09001
typical values
I_R (nA)
10
1
0.1
0.01
$T_j = 60°C$
25°C
1
10
V_R (V)
100


7Z08998
$V_R = 20V$
I_R (nA)
1
0.1
0.01
typ
0
20
40
T_j (°C)
60


7Z08997
$V_R = 20V$
I_R (nA)
1000
100
10
max
0
20
40
T_j (°C)
60


7Z09002
3
2
1
0
C_d
(pF)
f = 1 MHz
T_j = 25°C
max
typ
min
0.1
1
10
100
V_R (V)


7Z09000
1.5
1
0.5
0
r_D
(Ω)
f = 200 MHz
T_j = 25°C
max
typ
1
10
100
I_F (mA)

SILICON OXIDE PASSIVATED DIODE

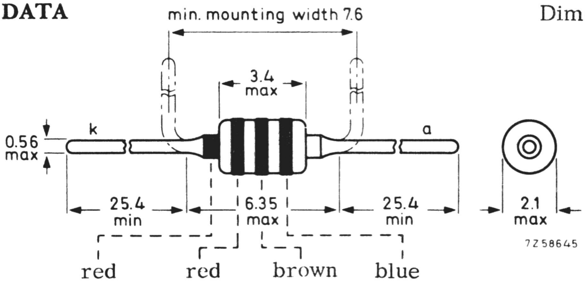
Whiskerless diode in a hardglass subminiature envelope. The diode is intended for low voltage regulation such as bias stabilizer in class B output stages, clipping, clamping and meter protection.

QUICK REFERENCE DATA

Repetitive peak reverse voltage	V_{RRM}	max.	10 V
Repetitive peak forward current	I_{FRM}	max.	150 mA
Storage temperature	T_{stg}		-65 to +200 °C
Junction temperature	T_j	max.	200 °C
Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	0.60 °C/mW
Forward voltage at $I_F = 0.2$ mA	V_F		500 to 620 mV
$I_F = 3.0$ mA	V_F		580 to 800 mV
$I_F = 15$ mA	V_F		700 to 1000 mV
Temperature coefficient at $I_F = 3$ mA	S_Z	typ.	-2 mV/°C

MECHANICAL DATA

Dimensions in mm


min. mounting width 7.6
3.4 max
0.56 max
k
a
25.4 min
6.35 max
25.4 min
2.1 max
7Z58645
red
red
brown
blue

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

Repetitive peak reverse voltage	V_{RRM}	max	10	V

Currents

Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	75	mA 1)
Forward current (d. c.)	I_F	max.	75	mA
Repetitive peak forward current	I_{FRM}	max.	150	mA
Non repetitive peak forward current $t = 1\ \mu s$	I_{FSM}	max.	1000	mA
$t = 1$ s	I_{FSM}	max.	250	mA

Temperatures

Storage temperature	T_{stg}	-65 to	+200	°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	0.60	°C/mW

CHARACTERISTICS $T_j = 25\ ^oC$ unless otherwise specified

Forward voltage

$I_F = 0.2$ mA	V_F	500 to	620	mV
$I_F = 3.0$ mA	V_F	580 to	800	mV
$I_F = 15$ mA	V_F	700 to	1000	mV

Reverse current

$V_R = 10$ V	I_R	<	1500	nA

---

1) For sinusoidal operation I_{FAV} = 48 mA

SILICON OXIDE PASSIVATED DIODE

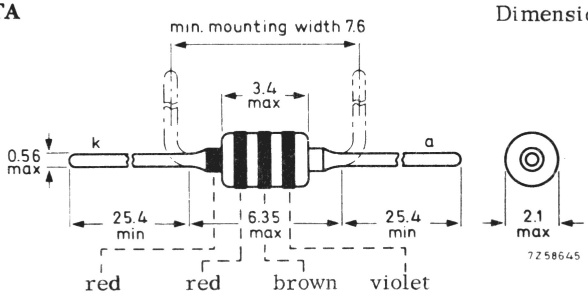
Whiskerless diode in a hardglass subminiature envelope. This diode is intended for general purpose consumer applications.

QUICK REFERENCE DATA

Continuous reverse voltage	V_R	max.	30	V
Repetitive peak forward current	I_{FRM}	max.	150	mA
Storage temperature	T_{stg}	-65 to	200	°C
Junction temperature	T_j	max.	200	°C
Thermal resistance from junction to ambient	$R_{th\ j-a}$	=	0.60	°C/mW
Forward voltage at I_F = 1 mA	V_F	<	0.7	V
I_F = 10 mA	V_F	<	1.0	V
I_F = 50 mA	V_F	<	1.5	V

MECHANICAL DATA

Dimensions in mm


min. mounting width 7.6
3.4 max
0.56 max
k
a
25.4 min
6.35 max
25.4 min
2.1 max
7Z58645
red
red
brown
violet

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages				
Continuous reverse voltage	V_R	max.	30	V
Repetitive peak reverse voltage	V_{RRM}	max.	30	V
Currents				
Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	75	mA [1]
Forward current (d. c.)	I_F	max.	75	mA
Repetitive peak forward current	I_{FRM}	max.	150	mA
Non repetitive peak forward current t = 1 μs	I_{FSM}	max.	2000	mA
t = 1 s	I_{FSM}	max.	500	mA
Temperatures				
Storage temperature	T_{stg}		-65 to +200	°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	0.60	°C/mW

CHARACTERISTICS $T_j = 25\ ^\circ C$ unless otherwise specified

Forward voltage				
I_F = 1 mA	V_F	<	0.7	V
I_F = 10 mA	V_F	<	1.0	V
I_F = 50 mA	V_F	<	1.5	V
Reverse current				
V_R = 10 V	I_R	<	50	nA
V_R = 30 V	I_R	<	200	nA
Diode capacitance				
V_R = 0; f = 1 MHz	C_d	<	5	pF

---

[1] For sinusoidal operation I_{FAV} = 48 mA

SILICON OXIDE PASSIVATED DIODE

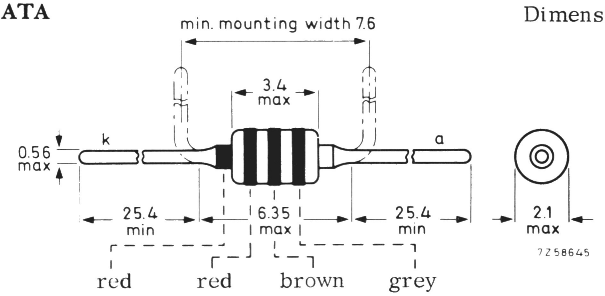
Whiskerless diode in a hardglass subminiature envelope. The diode is intended for general purpose consumer applications.

QUICK REFERENCE DATA

Continuous reverse voltage	V_R	max.	50	V
Repetitive peak forward current	I_{FRM}	max.	150	mA
Storage temperature	T_{stg}	-65 to	+200	^oC
Junction temperature	T_j	max.	200	^oC
Thermal resistance from junction to ambient	$R_{th\ j-a}$	=	0.60	$^oC/mW$
Forward voltage at I_F = 1 mA	V_F	<	0.7	V
I_F = 10 mA	V_F	<	1.0	V
I_F = 50 mA	V_F	<	1.5	V

MECHANICAL DATA

Dimensions in mm


min. mounting width 7.6
3.4
max
0.56
max
k
a
25.4
min
6.35
max
25.4
min
2.1
max
7Z58645
red
red
brown
grey

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages				
Continuous reverse voltage	V_R	max.	50	V
Repetitive peak reverse voltage	V_{RRM}	max.	50	V
Currents				
Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	75	mA [1]
Forward current (d. c.)	I_F	max.	75	mA
Repetitive peak forward current	I_{FRM}	max.	150	mA
Non repetitive peak forward current t = 1 µs	I_{FSM}	max.	2000	mA
t = 1 s	I_{FSM}	max.	500	mA
Temperatures				
Storage temperature	T_{stg}	-65 to	+200	°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	0.60	°C/mW

CHARACTERISTICS

Forward voltage				
I_F = 1 mA	V_F	<	0.7	V
I_F = 10 mA	V_F	<	1.0	V
I_F = 50 mA	V_F	<	1.5	V
Reverse current				
V_R = 25 V	I_R	<	50	nA
V_R = 50 V	I_R	<	200	nA
Diode capacitance				
V_R = 0; f = 1 MHz	C_d	<	5	pF

---

[1] For sinusoidal operation I_{FAV} = 48 mA

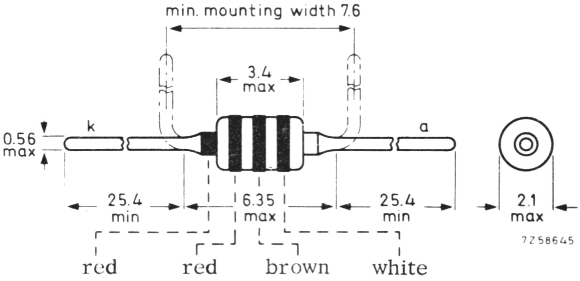
SILICON OXIDE PASSIVATED DIODE

Whiskerless diode in a hardglass subminiature envelope. The diode is intended for general purpose consumer applications.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	100	V
Repetitive peak forward current	I_{FRM}	max.	300	mA
Storage temperature	T_{stg}		-65 to +200	°C
Junction temperature	T_j	max.	200	°C
Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	0.60	°C/mW
Forward voltage at I_F = 1 mA	V_F	<	0.65	V
I_F = 10 mA	V_F	<	0.85	V
I_F = 100 mA	V_F	<	1.50	V

MECHANICAL DATA

Dimensions in mm


min. mounting width 7.6
3.4
max
0.56
max
k
a
25.4
min
6.35
max
25.4
min
2.1
max
7Z58645
red
red
brown
white

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages				
Continuous reverse voltage	V_R	max.	100	V
Repetitive peak reverse voltage	V_{RRM}	max.	100	V
Currents				
Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	100	mA
Forward current (d. c.)	I_F	max.	100	mA
Repetitive peak forward current	I_{FRM}	max.	300	mA
Non repetitive peak forward current $t = 1$ μs	I_{FSM}	max.	2000	mA
$t = 1$ s	I_{FSM}	max.	500	mA
Temperatures				
Storage temperature	T_{stg}	-65 to	+200	°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	0.60	°C/mW

CHARACTERISTICS $T_j = 25$ °C unless otherwise specified

Forward voltage				
$I_F = 1$ mA	V_F	<	0.65	V
$I_F = 10$ mA	V_F	<	0.85	V
$I_F = 100$ mA	V_F	<	1.50	V
Reverse current				
$V_R = 50$ V	I_R	<	200	nA
$V_R = 100$ V	I_R	<	500	nA
Diode capacitance				
$V_R = 0$; $f = 1$ MHz	C_d	<	5	pF

GENERAL PURPOSE DIODE

Silicon planar epitaxial diode in a DO-35 envelope; intended for general purposes and can also be used as regulator.

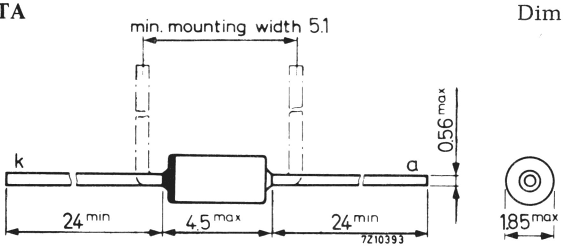
QUICK REFERENCE DATA

Repetitive peak reverse voltage	V_{RRM}	max.	10	V
Repetitive peak forward current	I_{FRM}	max.	400	mA
Storage temperature	T_{stg}		−65 to +200	°C
Junction temperature	T_j	max.	200	°C
Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	0.50	°C/mW
Forward voltage at I_F = 0.1 mA	V_F		460 to 520	mV
I_F = 1.0 mA	V_F		560 to 620	mV
I_F = 10 mA	V_F		680 to 750	mV
I_F = 100 mA	V_F		825 to 950	mV
Diode capacitance at V_R = 0; f = 1 MHz	C_d	<	2.5	pF

MECHANICAL DATA

Dimensions in mm

DO-35



Cathode indicating by coloured mark or by broad band if colour coded (see General Section)

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages				
Repetitive peak reverse voltage	V_{RRM}	max.	10	V
Currents				
Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	200	mA [1]
Forward current (d.c.)	I_F	max.	200	mA
Repetitive peak forward current	I_{FRM}	max.	400	mA
Non repetitive peak forward current t = 1 μs	I_{FSM}	max.	4000	mA
t = 1 s	I_{FSM}	max.	1000	mA
Temperatures				
Storage temperature	T_{stg}	-65 to	+200	°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

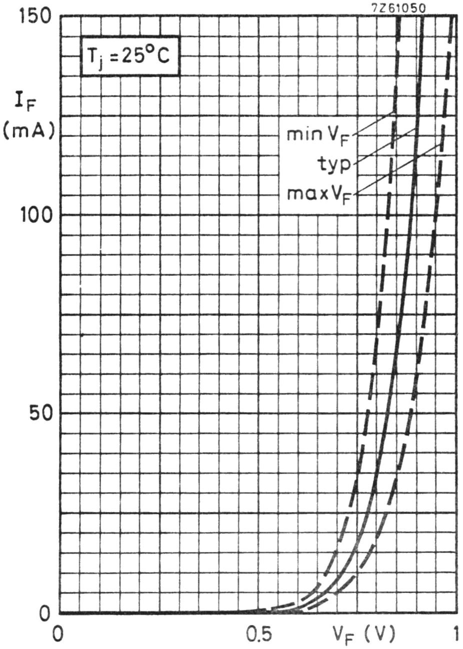
From junction to ambient in free air	$R_{th\,j\text{-}a}$	=	0.50	°C/mW

CHARACTERISTICS

Forward voltage				
$I_F = 0.1$ mA	V_F	460 to	520	mV
$I_F = 1.0$ mA	V_F	560 to	620	mV
$I_F = 5.0$ mA	V_F	640 to	700	mV
$I_F = 10$ mA	V_F	680 to	750	mV
$I_F = 100$ mA	V_F	825 to	950	mV
Reverse current				
$V_R = 10$ V	I_R	<	1500	nA
Diode capacitance				
$V_R = 0$; f = 1 MHz	C_d	<	2.5	pF

---

[1] For sinusoidal operation $I_{FAV} = 130$ mA


7Z61050
Tj = 25°C
I_F (mA)
150
100
50
0
min V_F
typ
max V_F
0
0.5
V_F (V)
1

GENERAL PURPOSE DIODE

Silicon planar epitaxial diode in a DO-35 envelope; intended for general purposes

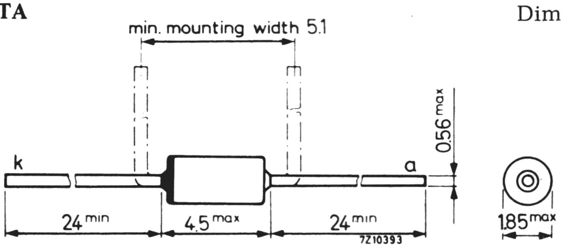
QUICK REFERENCE DATA

Continuous reverse voltage	V_R	max.	30	V
Repetitive peak forward current	I_{FRM}	max.	400	mA
Storage temperature	T_{stg}	−65 to	200	^oC
Junction temperature	T_j	max.	200	^oC
Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	0.50	$^oC/mW$
Forward voltage at I_F = 1 mA	V_F	<	625	mV
I_F = 100 mA	V_F	<	950	mV
I_F = 200 mA	V_F	<	1050	mV
Diode capacitance at V_R = 0; f = 1 MHz	C_d	<	2.5	pF

MECHANICAL DATA

Dimensions in mm

DO-35



Cathode indicating by coloured mark or by broad band if colour coded (see General Section)

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages				
Continuous reverse voltage	V_R	max.	30	V
Repetitive peak reverse voltage	V_{RRM}	max.	30	V
Currents				
Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	200	mA [1])
Forward current (d.c.)	I_F	max.	200	mA
Repetitive peak forward current	I_{FRM}	max.	400	mA
Non repetitive peak forward current t = 1 μs	I_{FSM}	max.	4000	mA
t = 1 s	I_{FSM}	max.	1000	mA
Temperatures				
Storage temperature	T_{stg}	-65 to	+200	°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

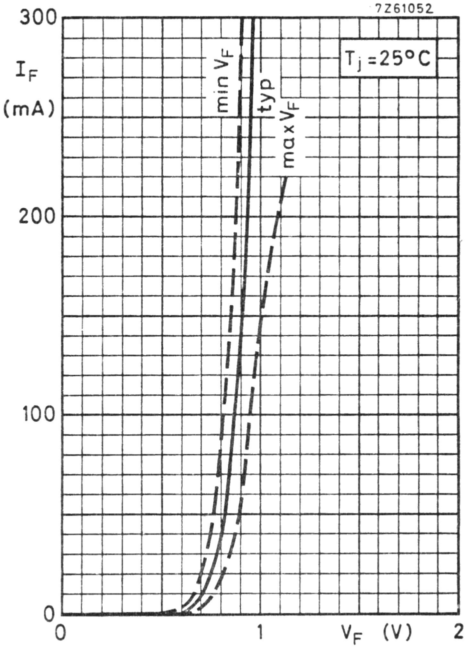
From junction to ambient in free air	$R_{th\,j\text{-}a}$	=	0.50	°C/mW

CHARACTERISTICS $T_j = 25\,^{\circ}C$ unless otherwise specified

Forward voltage				
$I_F = 1$ mA	V_F	<	625	mV
$I_F = 100$ mA	V_F	<	950	mV
$I_F = 200$ mA	V_F	<	1050	mV
Reverse current				
$V_R = 10$ V	I_R	<	25	nA
$V_R = 30$ V	I_R	<	200	nA
Diode capacitance				
$V_R = 0$; f = 1 MHz	C_d	<	2.5	pF

---

1) For sinusoidal operation $I_{FAV} = 130$ mA


7Z61052
300
200
100
0
I_F
(mA)
$T_j = 25°C$
min V_F
typ
max V_F
0
1
2
V_F (V)

GENERAL PURPOSE DIODE

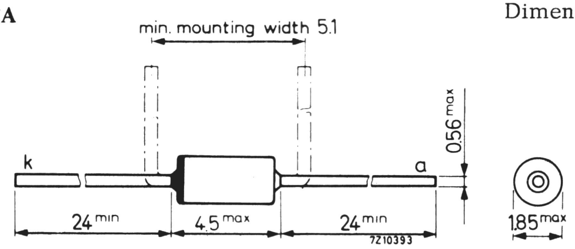
Silicon planar epitaxial diode in a DO-35 envelope; intended for general purpose diodes.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	50	V
Repetitive peak forward current	I_{FRM}	max.	150	mA
Storage temperature	T_{stg}		−65 to +200	°C
Junction temperature	T_j	max.	200	°C
Thermal resistance from junction to ambient	$R_{th\,j\text{-}a}$	=	0.60	°C/mW
Forward voltage at I_F = 1 mA	V_F	<	700	mV
I_F = 10 mA	V_F	<	900	mV
I_F = 50 mA	V_F	<	1100	mV
Diode capacitance at V_R = 0; f = 1 MHz	C_d	<	2.0	pF

MECHANICAL DATA

Dimensions in mm

DO-35



Cathode indicating by coloured mark or by broad band if colour coded (see General Section)

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages				
Continuous reverse voltage	V_R	max.	50	V
Repetitive peak reverse voltage	V_{RRM}	max.	50	V
Currents				
Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	75	mA [1]
Forward current (d.c.)	I_F	max.	75	mA
Repetitive peak forward current	I_{FRM}	max.	150	mA
Non repetitive peak forward current $t = 1\ \mu s$	I_{FSM}	max.	2000	mA
$t = 1$ s	I_{FSM}	max.	500	mA
Temperatures				
Storage temperature	T_{stg}	-65 to	+200	°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

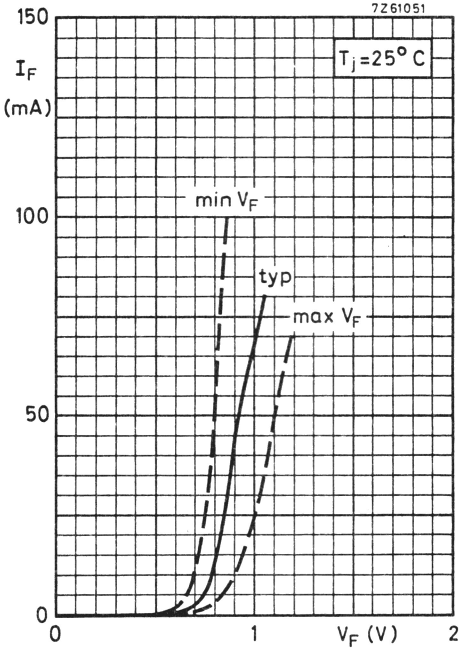
From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.60	°C/mW

CHARACTERISTICS

Forward voltage				
$I_F = 1$ mA	V_F	<	700	mV
$I_F = 10$ mA	V_F	<	900	mV
$I_F = 50$ mA	V_F	<	1100	mV
Reverse current				
$V_R = 25$ V	I_R	<	50	nA
$V_R = 50$ V	I_R	<	200	nA
Diode capacitance				
$V_R = 0$; f = 1 MHz	C_d	<	2	pF

---

1) For sinusoidal operation $I_{FAV} = 48$ mA


7Z61051
$T_j = 25°C$
I_F (mA)
150
100
50
0
min V_F
typ
max V_F
0
1
V_F (V)
2

ULTRA HIGH SPEED DIODE

Silicon planar epitaxial ultra high speed high conductance diode in a DO-35 envelope.
The BAV10 is primarily intended for core gating in very fast memories.

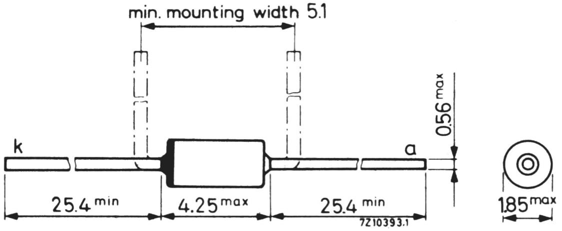
QUICK REFERENCE DATA

Continuous reverse voltage	V_R	max.	60	V
Repetitive peak reverse voltage	V_{RRM}	max.	60	V
Repetitive peak forward current	I_{FRM}	max.	600	mA
Junction temperature	T_j	max.	200	°C
Forward voltage at I_F = 200 mA	V_F	<	1.0	V
Reverse recovery time when switched from I_F = 400 mA to I_R = 400 mA; R_L = 100 Ω measured at I_R = 40 mA	t_{rr}	<	6	ns
Recovered charge when switched from I_F = 10 mA to V_R = 5 V; R_L = 500 Ω	Q_s	<	50	pC

MECHANICAL DATA

Dimensions in mm

DO-35



Cathode indicated by coloured mark or by broad band if colour coded (see General Section)

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages				
Continuous reverse voltage	V_R	max.	60	V
Repetitive peak reverse voltage	V_{RRM}	max.	60	V [1]
Currents				
Average rectified forward current	I_{FAV}	max.	300	mA [2]
Forward current (d.c.)	I_F	max.	300	mA
Repetitive peak forward current	I_{FRM}	max.	600	mA
Non repetitive peak forward current $t = 1\ \mu s$	I_{FSM}	max.	4000	mA
$t = 1$ s	I_{FSM}	max.	1000	mA
Temperatures				
Storage temperature	T_{stg}		-65 to +200	°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air at maximum lead length	$R_{th\ j\text{-}a}$	=	0.5	°C/mW

CHARACTERISTICS $T_j = 25\ ^{\circ}C$ unless otherwise specified

Forward voltages				
$I_F = 10$ mA	V_F	<	750	mV
$I_F = 200$ mA	V_F	<	1.0	V
$I_F = 200$ mA; $T_j = 100\ ^{\circ}C$	V_F	<	0.95	V
$I_F = 500$ mA	V_F	<	1.25	V
Reverse currents				
$V_R = 60$ V	I_R	<	100	nA
$V_R = 60$ V; $T_j = 150\ ^{\circ}C$	I_R	<	100	µA
Diode capacitance				
$V_R = 0$; $f = 1$ MHz	C_d	<	2.5	pF

---

[1] Measured at zero lifetime at $I_R = 10\ \mu A$; $V_R = 75$ V.

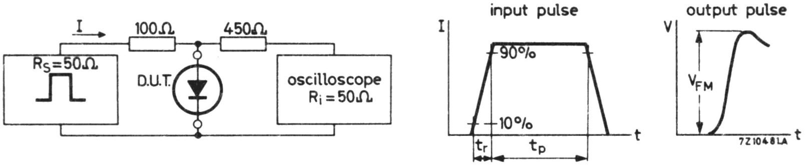
[2] For sinusoidal operation see page 6. For pulse operation see page 5.

CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

Forward recovery voltage when switched to

I_F = 400 mA; t_r = 30 ns	V_{FM}	< 2.0 V
I_F = 400 mA; t_r = 100 ns	V_{FM}	< 1.5 V

Test circuit:


I
100Ω
450Ω
R_S=50Ω
D.U.T.
oscilloscope
R_i=50Ω
input pulse
I
90%
10%
t
t_r
t_p
output pulse
V
V_{FM}
t
7Z10481A

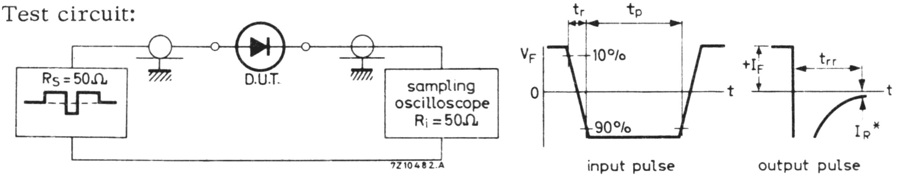
Current pulse: Rise time	t_{r1} = 30 ns	Oscilloscope:			
Rise time	t_{r2} = 100 ns				
Pulse duration	t_p = 300 ns	Rise time	t_r	=	0.35 ns
Duty cycle	δ = 0.01	Input capacitance	C_i	≤	1 pF

Circuit capacitance $C \leq 20$ pF (C = Oscilloscope + parasitical capacitance)

Reverse recovery time when switched from

I_F = 400 mA to I_{RM} = 400 mA; R_L = 100 Ω
measured at I_R = 40 mA t_{rr} < 6 ns

Test circuit:


R_S=50Ω
D.U.T.
sampling
oscilloscope
R_i=50Ω
7Z10482.A
t_r
t_p
V_F
10%
0
t
90%
input pulse
$+I_F$
t_{rr}
t
I_R*
output pulse

*) I_R = 40 mA

Reverse pulse: Rise time	t_r = 0.6 ns	Oscilloscope:		
Pulse duration	t_p = 100 ns	Rise time	t_r	= 0.35 ns
Duty cycle	δ = 0.05			

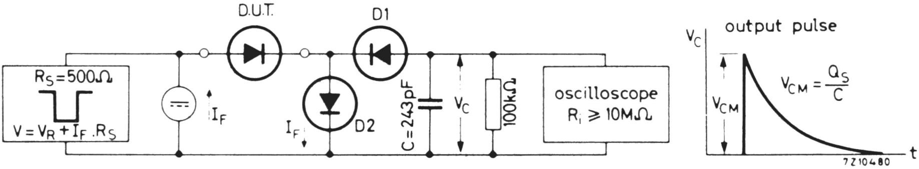
Circuit capacitance $C \leq 1$ pF (C = Oscilloscope + parasitical capacitance)

CHARACTERISTICS (continued)

Recovered charge when switched from

I_F = 10 mA to V_R = 5 V; R_L = 500 Ω Q_s < 50 pC

Test circuit:


D.U.T.
D1
$R_S = 500\Omega$
$V = V_R + I_F . R_S$
I_F
I_F
D2
C = 243pF
V_C
100kΩ
oscilloscope
$R_i \geq 10M\Omega$
output pulse
V_C
V_{CM}
$V_{CM} = \frac{Q_S}{C}$
t
7Z10480

D1 = BAW62

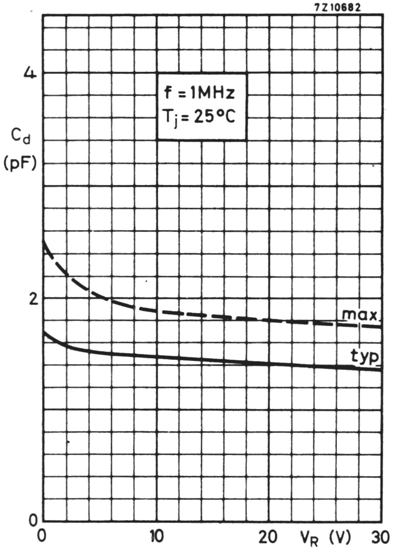
D2 = diode with minority carrier lifetime at 10 mA: < 200 ps

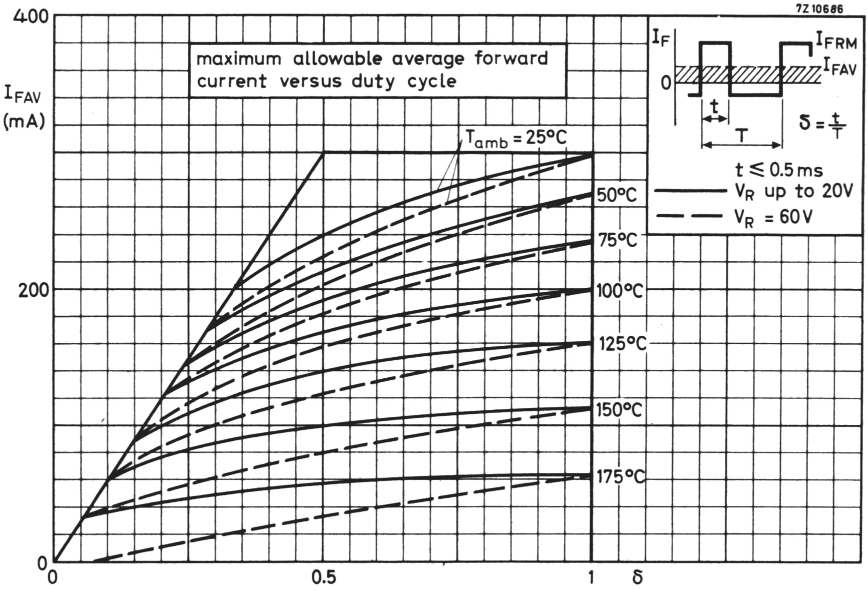
Reverse pulse : Rise time t_r = 2 ns

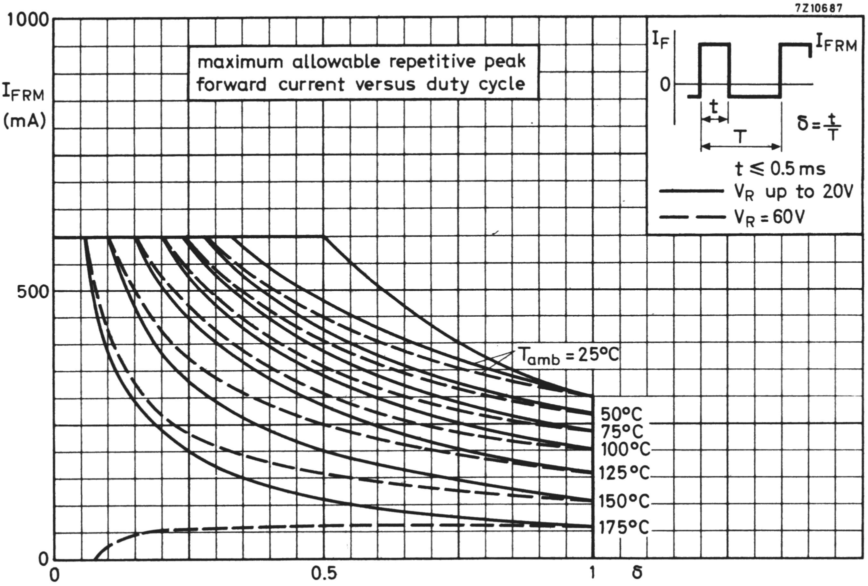
Pulse duration t_p = 400 ns

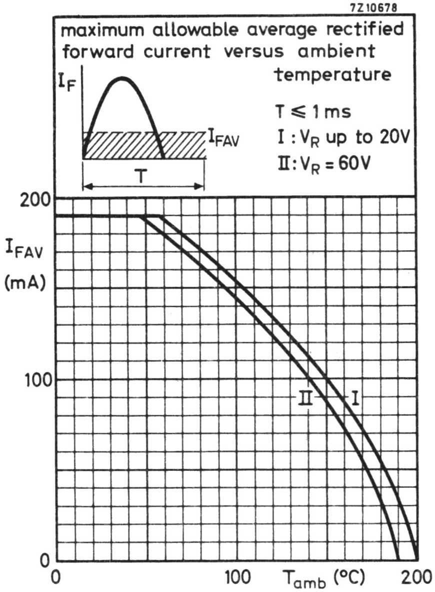
Duty cycle δ = 0.02

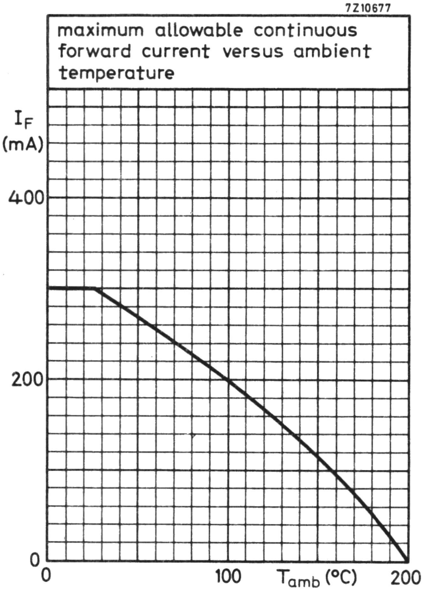
Circuit capacitance C ≤ 7 pF (C = Oscilloscope + parasitical capacitance)

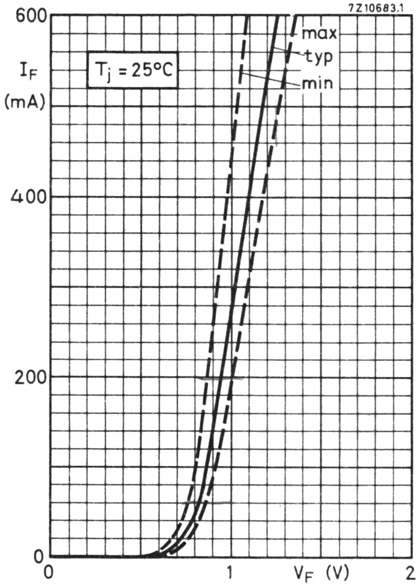


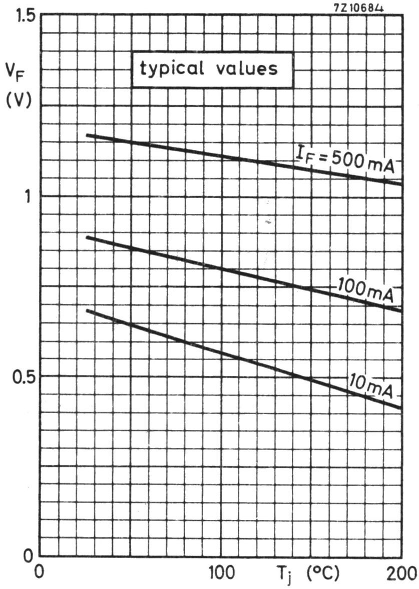

7Z10686
maximum allowable average forward current versus duty cycle
I_{FAV} (mA)
400
200
0
0
0.5
1
δ
$T_{amb} = 25°C$
50°C
75°C
100°C
125°C
150°C
175°C
I_F
I_{FRM}
I_{FAV}
0
t
T
$\delta = \frac{t}{T}$
$t \leq 0.5$ ms
V_R up to 20V
V_R = 60V

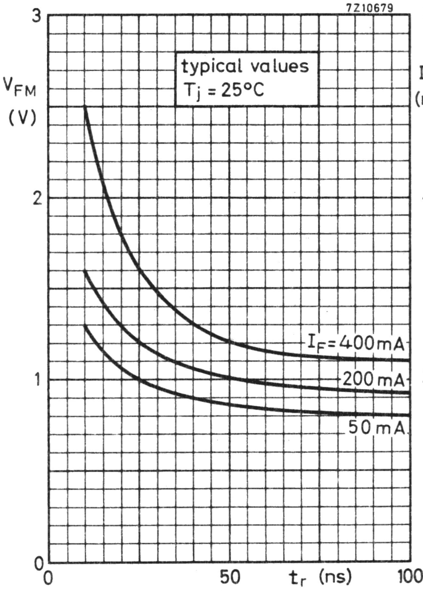

7Z10687
maximum allowable repetitive peak forward current versus duty cycle
I_{FRM} (mA)
1000
500
0
0
0.5
1
δ
$T_{amb} = 25°C$
50°C
75°C
100°C
125°C
150°C
175°C
I_F
I_{FRM}
0
t
T
$\delta = \frac{t}{T}$
$t \leq 0.5$ ms
V_R up to 20V
V_R = 60V

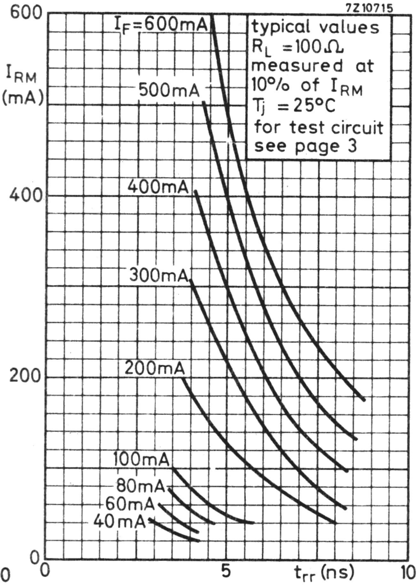

7Z10678
maximum allowable average rectified forward current versus ambient temperature
I_F
I_{FAV}
T
T ⩽ 1 ms
I : V_R up to 20V
II: V_R = 60V
200
I_{FAV}
(mA)
100
0
II
I
0
100
T_{amb} (°C)
200

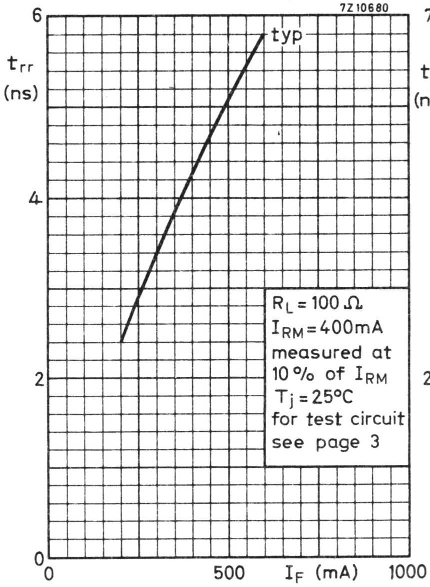

7Z10677
maximum allowable continuous forward current versus ambient temperature
I_F
(mA)
400
200
0
0
100
T_{amb} (°C)
200

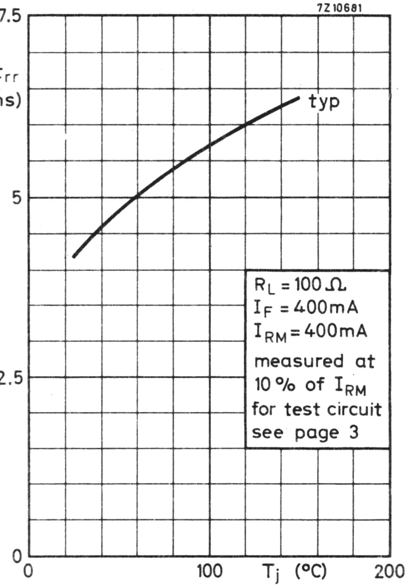

7Z10683.1
600
I_F
(mA)
T_j = 25°C
max
typ
min
400
200
0
0
1
V_F (V)
2

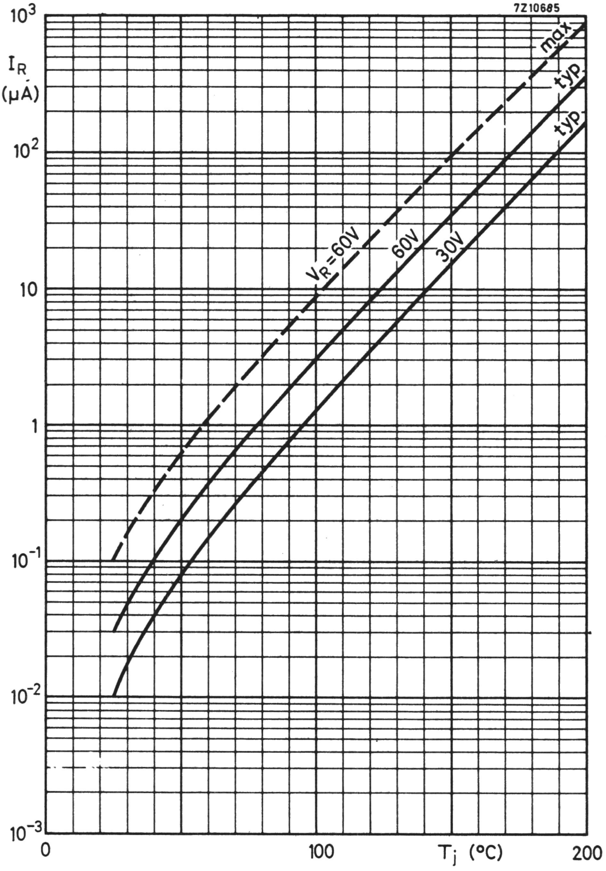

7Z10684
1.5
V_F
(V)
typical values
I_F = 500 mA
1
100 mA
0.5
10 mA
0
0
100
T_j (°C)
200


7Z10679
typical values
$T_j = 25°C$
V_{FM} (V)
0
1
2
3
$I_F = 400 mA$
200 mA
50 mA
0
50
t_r (ns)
100


7Z10715
typical values
$R_L = 100 \Omega$
measured at 10% of I_{RM}
$T_j = 25°C$
for test circuit see page 3
I_{RM} (mA)
0
200
400
600
$I_F = 600 mA$
500mA
400mA
300mA
200mA
100mA
80mA
60mA
40mA
0
5
t_{rr} (ns)
10


7Z10680
t_{rr} (ns)
0
2
4
6
typ
$R_L = 100 \Omega$
$I_{RM} = 400 mA$
measured at 10% of I_{RM}
$T_j = 25°C$
for test circuit see page 3
0
500
I_F (mA)
1000


7Z10681
t_{rr} (ns)
0
2.5
5
7.5
typ
$R_L = 100 \Omega$
$I_F = 400 mA$
$I_{RM} = 400 mA$
measured at 10% of I_{RM}
for test circuit see page 3
0
100
T_j (°C)
200


7Z10685
10^3
I_R
(μA)
10^2
10
1
10^{-1}
10^{-2}
10^{-3}
0
100
T_j (°C)
200
max
typ
typ
V_R=60V
60V
30V

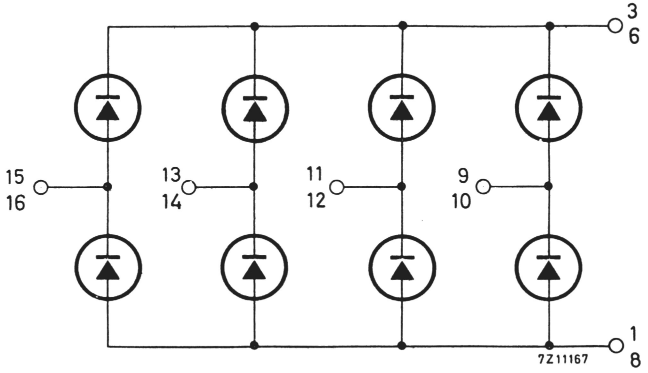
MULTIPLE DIODE

Diode array consisting of 8 silicon planar epitaxial diodes in a plastic DIL envelope. It is intended for core-gating in very fast memories.

QUICK REFERENCE DATA

			Each diode	Total device	
Reverse voltage	V_R	max.	60		V
Repetitive peak reverse voltage	V_{RRM}	max.	60		V
Forward current (d.c.)	I_F	max.	300	1000	mA
Repetitive peak forward current	I_{FRM}	max.	900	2700	mA
Junction temperature	T_j	max.	150	150	°C
Reverse recovery time when switched from I_F = 400 mA to I_{RM} = 400 mA; R_L = 100 Ω; measured at I_R = 40 mA	t_{rr}	<	6		ns

PACKAGE OUTLINE see page 4



RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

INDIVIDUAL DIODE

Voltages

Continuous reverse voltage	V_R	max.	60	V
Repetitive peak reverse voltage	V_{RRM}	max.	60	V

Currents

Forward current (d.c.)	I_F	max.	300	mA
Repetitive peak forward current f > 1 MHz	I_{FRM}	max.	600	mA
Repetitive peak forward current pulse repetition frequency (p.r.f.) = 4 MHz $\delta < 0.3$	I_{FRM}	max.	900	mA
Non repetitive peak forward current t < 1 s	I_{FSM}	max.	1000	mA
t < 1 µs	I_{FSM}	max.	4000	mA

Temperatures

Storage temperature	T_{stg}	−55 to	+150	°C
Junction temperature	T_j	max.	150	°C

TOTAL DEVICE Take care not to exceed the individual ratings

Currents

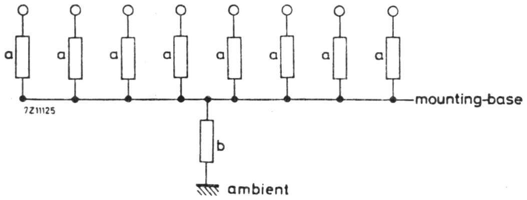
Forward current (d.c.)	I_F	max.	1000	mA
Repetitive peak forward current f > 1 MHz	I_{FRM}	max.	2000	mA
Repetitive peak forward current pulse repetition frequency (p.r.f.) = 4MHz $\delta < 0.3$	I_{FRM}	max.	2700	mA
Non repetitive peak forward current t < 1 s	I_{FSM}	max.	4000	mA

THERMAL RESISTANCE

From junction to ambient

1 diode dissipating	$R_{th\ j\text{-}a}$	=	280	°C/W
all diodes dissipating	$R_{th\ j\text{-}a}$	=	80	°C/W

The thermal resistance can be replaced by the following equivalent circuit:



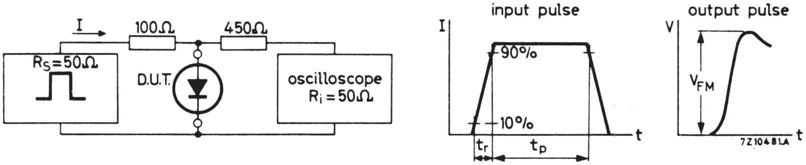
The temperature difference between junction and ambient can be found from the relation: $\Delta T_{j\text{-}amb} = P_{sd}.a + P_{tot}.b$

where: P_{sd} = dissipation of a single diode a = 220 °C/W
P_{tot} = dissipation of total device b = 55 °C/W

CHARACTERISTICS $T_j = 25\,^{\circ}C$ unless otherwise specified

Reverse current				
$V_R = 60$ V	I_R	$<$	400	nA
$V_R = 60$ V; $T_j = 150\,^{\circ}C$	I_R	$<$	400	µA
Reverse breakdown voltage; $I_R = 10$ µA	$V_{(BR)R}$	$>$	75	V
Forward voltage				
$I_F = 10$ mA	V_F	$<$	750	mV
$I_F = 200$ mA	V_F	$<$	1050	mV
$I_F = 500$ mA	V_F	$>$	1035	mV
		$<$	1300	mV
$I_F = 800$ mA	V_F	$<$	1600	mV
Diode capacitance				
$V_R = 0$; f = 1 MHz	C_d	$<$	4	pF
Forward recovery voltage				
$I_F = 400$ mA; $t_r = 30$ ns	V_{FM}	$<$	2.0	V
$I_F = 400$ mA; $t_r = 100$ ns	V_{FM}	$<$	1.5	V

Test circuit:


I
100Ω
450Ω
$R_S = 50\Omega$
D.U.T.
oscilloscope $R_i = 50\Omega$
input pulse
I
90%
10%
t_r
t_p
t
output pulse
V
V_{FM}
t
7Z10481.A

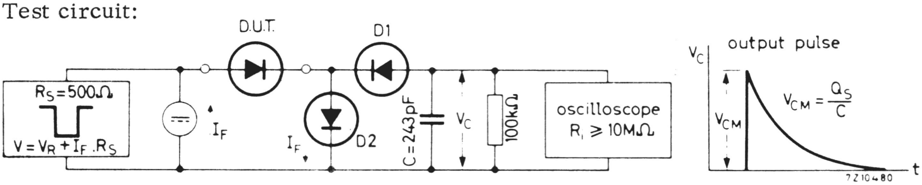
Current pulse: Rise time $t_{r1} = 30$ ns
Rise time $t_{r2} = 100$ ns
Pulse duration $t_p = 300$ ns
Duty cycle $\delta = 0.01$

Oscilloscope:
Rise time $t_r = 0.35$ ns
Input capacitance $C_i \leq 1$ pF

Circuit capacitance $C < 20$ pF (C = Oscilloscope + parasitical capacitance)

Recovered charge when switched from $I_F = 10$ mA to $V_R = 5$ V; $R_L = 500\ \Omega$	Q_s	$<$	50	pC

Test circuit:


D.U.T.
D1
$R_S = 500\Omega$
$V = V_R + I_F . R_S$
I_F
I_F
D2
C = 243pF
V_C
100kΩ
oscilloscope $R_i \geq 10M\Omega$
output pulse
V_C
V_{CM}
$V_{CM} = \frac{Q_S}{C}$
t
7Z10480

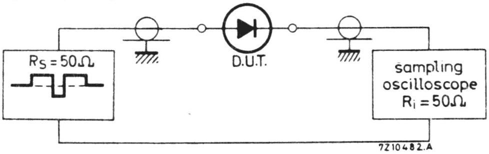
D1 = BAW62
D2 = diode with minority carrier lifetime at 10 mA: < 200 ps
Reverse pulse: Rise time $t_r = 2$ ns
Pulse duration $t_p = 400$ ns
Duty cycle $\delta = 0.02$
Circuit capacitance $C < 7$ pF (C = Oscilloscope + parasitical capacitance)

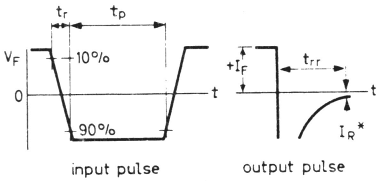
CHARACTERISTICS (continued) $T_j = 25\,^{\circ}C$ unless otherwise specified

Reverse recovery time when switched from

$I_F = 400$ mA to $I_{RM} = 400$ mA; $R_L = 100\ \Omega$
measured at $I_R = 40$ mA $t_{rr} < 6$ ns

Test circuit:


$R_S = 50\Omega$
D.U.T.
sampling oscilloscope $R_i = 50\Omega$
7Z10482.A


t_r
t_p
V_F
10%
0
t
90%
input pulse
$+I_F$
t_{rr}
t
I_R*
output pulse

*) $I_R = 40$ mA

Reverse pulse: Rise time $t_r = 0.6$ ns

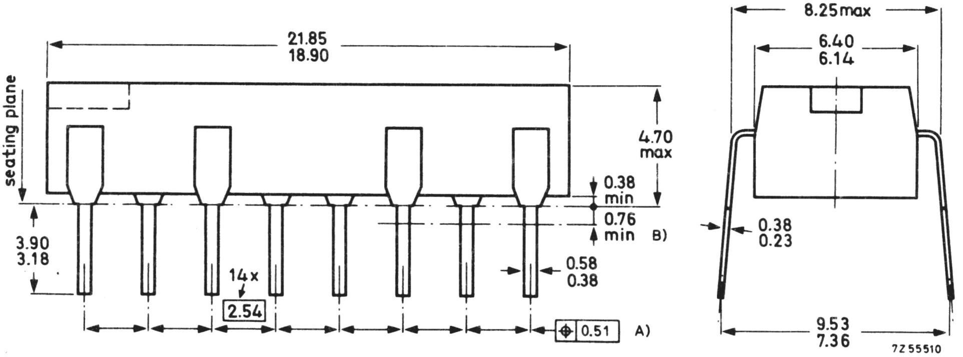
Pulse diration $t_p = 100$ ns

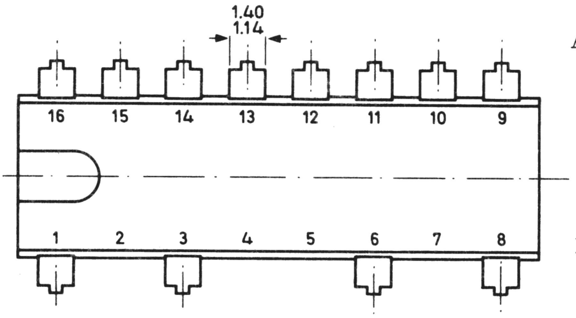
Duty cycle $\delta = 0.05$

Oscilloscope:

Rise time $t_r = 0.35$ ns

Circuit capacitance $C \leq 1$ pF (C = Oscilloscope + parasitical capacitance)

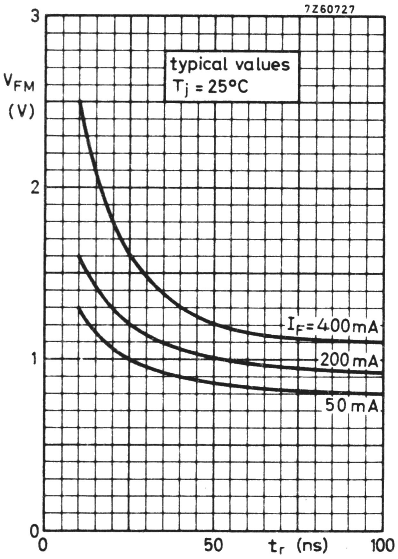

21.85
18.90
seating plane
4.70 max
0.38 min
0.76 min
B)
3.90
3.18
14x
2.54
0.58
0.38
0.51
A)
8.25max
6.40
6.14
0.38
0.23
9.53
7.36
7Z55510

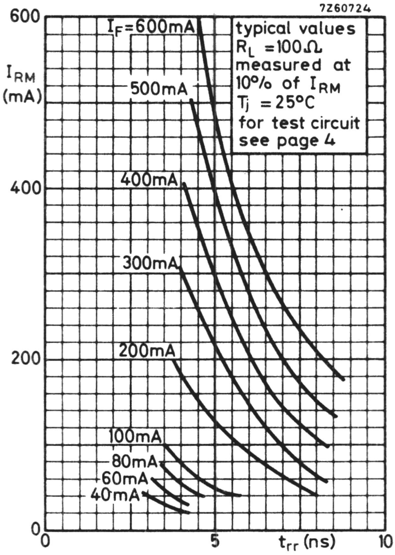

1.40
1.14
16
15
14
13
12
11
10
9
1
2
3
4
5
6
7
8

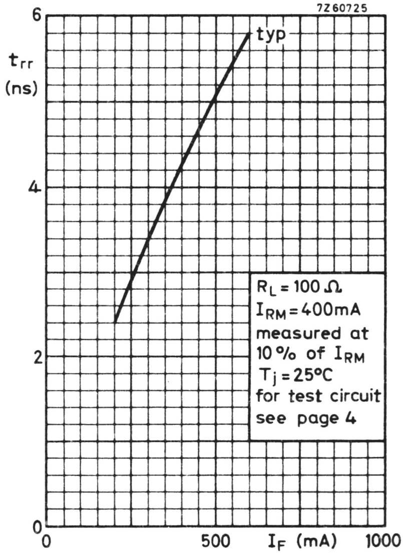
top view

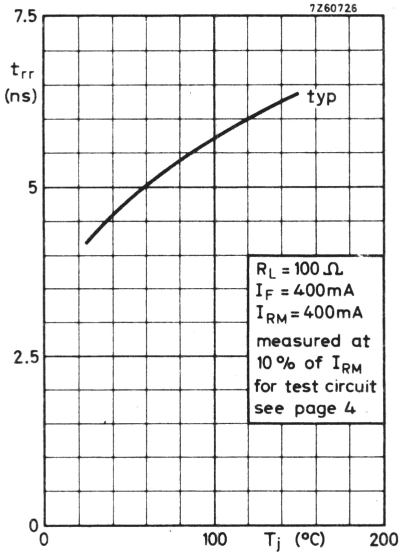
A) Centre-lines of all leads are within ± 0.254 mm of the nominal positions shown; in the worst case, the spacing between any two leads may deviate from nominal by ± 0.51 mm.

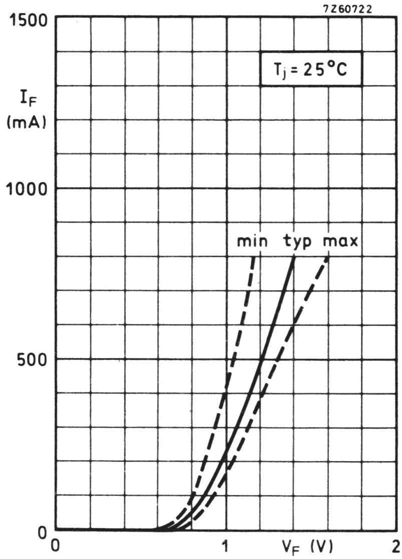
B) Lead spacing tolerances apply from seating plane to the line indicated.

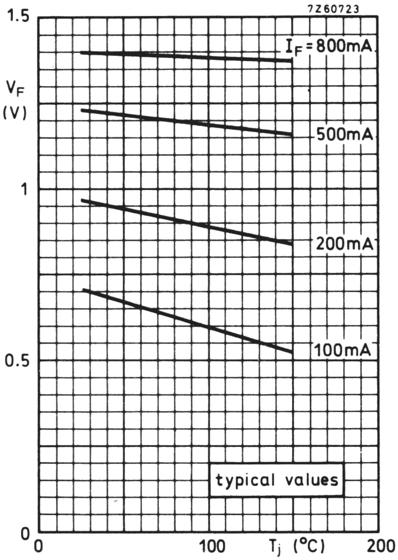

7Z60727
typical values
T_j = 25°C
V_{FM} (V)
3
2
1
0
I_F = 400 mA
200 mA
50 mA
0
50
t_r (ns)
100

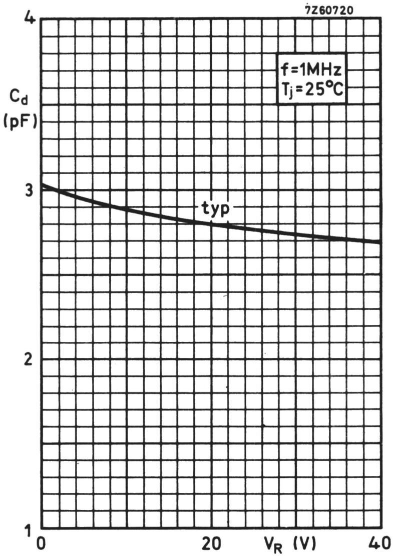

7Z60724
typical values
R_L = 100 Ω
measured at 10% of I_{RM}
T_j = 25°C
for test circuit see page 4
I_{RM} (mA)
600
400
200
0
I_F = 600 mA
500 mA
400 mA
300 mA
200 mA
100 mA
80 mA
60 mA
40 mA
0
5
t_{rr} (ns)
10

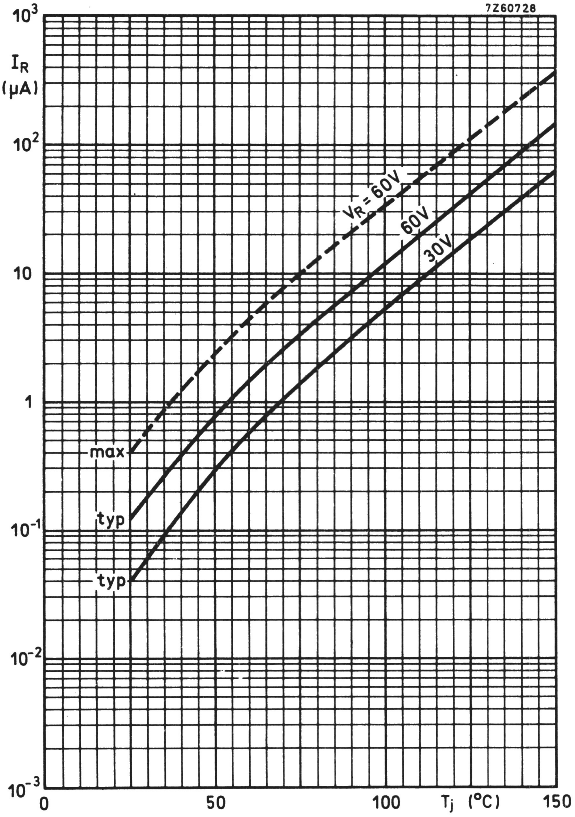

7Z60725
typ
t_{rr} (ns)
6
4
2
0
R_L = 100 Ω
I_{RM} = 400 mA
measured at 10% of I_{RM}
T_j = 25°C
for test circuit see page 4
0
500
I_F (mA)
1000


7Z60726
typ
t_{rr} (ns)
7.5
5
2.5
0
R_L = 100 Ω
I_F = 400 mA
I_{RM} = 400 mA
measured at 10% of I_{RM}
for test circuit see page 4
0
100
T_j (°C)
200


7Z60722
T_j = 25 °C
I_F (mA)
1500
1000
500
0
min
typ
max
0
1
V_F (V)
2


7Z60723
1.5
V_F (V)
1
0.5
0
I_F = 800mA
500mA
200mA
100mA
typical values
0
100
T_j (°C)
200


7Z60720
4
C_d (pF)
3
2
1
f=1MHz
T_j=25°C
typ
0
20
V_R (V)
40


7Z60728
I_R (μA)
10^3
10^2
10
1
10^{-1}
10^{-2}
10^{-3}
max
typ
typ
V_R = 60V
60V
30V
0
50
100
T_j (°C)
150

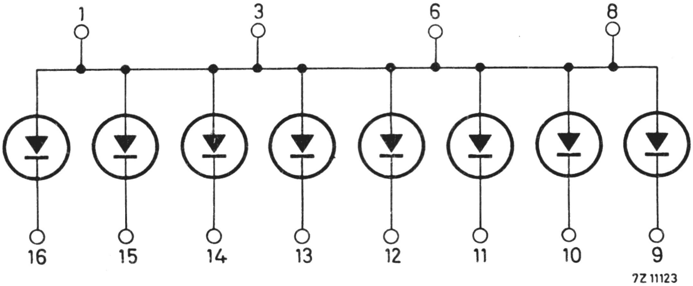
MULTIPLE DIODE

Diode array consisting of 8 silicon planar epitaxial diodes in a plastic DIL envelope. It is intended for core-gating in very fast memories.

QUICK REFERENCE DATA

			Each diode	Total device	
Reverse voltage	V_R	max.	60		V
Repetitive peak reverse voltage	V_{RRM}	max.	60		V
Forward current (d.c.)	I_F	max.	300	1000	mA
Repetitive peak forward current	I_{FRM}	max.	900	2700	mA
Junction temperature	T_j	max.	150	150	°C
Reverse recovery time when switched from I_F = 400 mA to I_{RM} = 400 mA; R_L = 100 Ω; measured at I_R = 40 mA	t_{rr}	<	6		ns

PACKAGE OUTLINE see page 4



RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

INDIVIDUAL DIODE

Voltages

Continuous reverse voltage	V_R	max.	60	V
Repetitive peak reverse voltage	V_{RRM}	max.	60	V

Currents

Forward current (d.c.)	I_F	max.	300	mA
Repetitive peak forward current f > 1 MHz	I_{FRM}	max.	600	mA
Repetitive peak forward current pulse repetition frequency (p.r.f.) = 4 MHz $\delta < 0.3$	I_{FRM}	max.	900	mA
Non repetitive peak forward current t < 1 s	I_{FSM}	max.	1000	mA
t < 1 µs	I_{FSM}	max.	4000	mA

Temperatures

Storage temperature	T_{stg}	-55 to	+150	°C
Junction temperature	T_j	max.	150	°C

TOTAL DEVICE Take care not to exceed the individual ratings

Currents

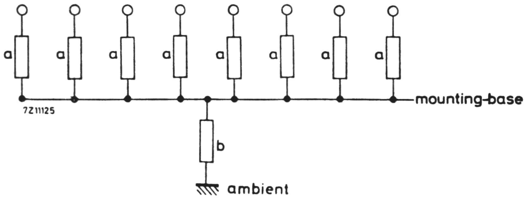
Forward current (d.c.)	I_F	max.	1000	mA
Repetitive peak forward current f > 1 MHz	I_{FRM}	max.	2000	mA
Repetitive peak forward current pulse repetition frequency (p.r.f.) = 4 MHz $\delta < 0.3$	I_{FRM}	max.	2700	mA
Non repetitive peak forward current t < 1 s	I_{FSM}	max.	4000	mA

THERMAL RESISTANCE

From junction to ambient

1 diode dissipating	$R_{th\ j\text{-}a}$	=	280	°C/W
all diodes dissipating	$R_{th\ j\text{-}a}$	=	80	°C/W

The thermal resistance can be replaced by the following equivalent circuit:



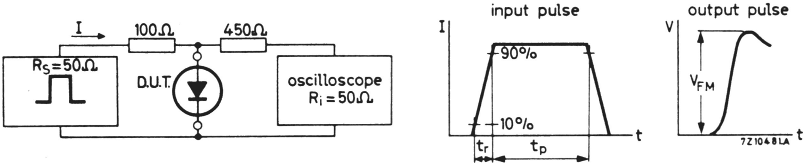
The temperature difference between junction and ambient can be found from the relation: $\Delta T_{j\text{-amb}} = P_{sd} \cdot a + P_{tot} \cdot b$

where: P_{sd} = dissipation of a single diode   a = 220 °C/W
P_{tot} = dissipation of total device   b = 55 °C/W

CHARACTERISTICS $T_j = 25\,^{o}C$ unless otherwise specified

Reverse current				
$V_R = 60$ V	I_R	<	100	nA
$V_R = 60$ V; $T_j = 150\,^{o}C$	I_R	<	100	μA
Reverse breakdown voltage; $I_R = 10$ μA	$V_{(BR)R}$	>	75	V
Forward voltage				
$I_F = 10$ mA	V_F	<	750	mV
$I_F = 200$ mA	V_F	<	1050	mV
$I_F = 500$ mA	V_F	>	1035	mV
		<	1300	mV
$I_F = 800$ mA	V_F	<	1600	mV
Diode capacitance				
$V_R = 0$; f = 1 MHz	C_d	<	3	pF
Forward recovery voltage				
$I_F = 400$ mA; $t_r = 30$ ns	V_{FM}	<	2.0	V
$I_F = 400$ mA; $t_r = 100$ ns	V_{FM}	<	1.5	V

Test circuit:


I
100Ω
450Ω
$R_S = 50\Omega$
D.U.T.
oscilloscope
$R_i = 50\Omega$
input pulse
I
90%
10%
t
t_r
t_p
output pulse
V
V_{FM}
t
7Z10481A

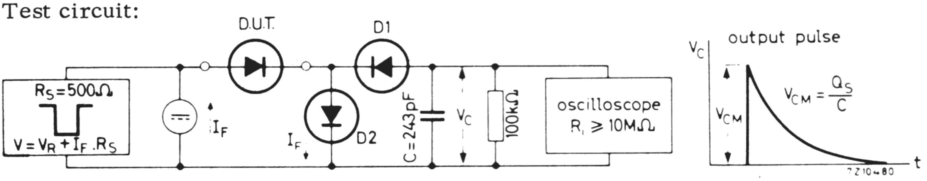
Current pulse: Rise time t_{r1} = 30 ns
Rise time t_{r2} = 100 ns
Pulse duration t_p = 300 ns
Duty cycle δ = 0.01

Oscilloscope:
Rise time $t_r = 0.35$ ns
Input capacitance $C_i \leq 1$ pF

Circuit capacitance $C < 20$ pF (C = Oscilloscope + parasitical capacitance)

Recovered charge when switched from				
$I_F = 10$ mA to $V_R = 5$ V; $R_L = 500$ Ω	Q_s	<	50	pC

Test circuit:


D.U.T.
D1
$R_S = 500\Omega$
$V = V_R + I_F . R_S$
I_F
I_F
D2
C = 243pF
V_C
100kΩ
oscilloscope
$R_i \geqslant 10M\Omega$
V_C
output pulse
V_{CM}
$V_{CM} = \frac{Q_S}{C}$
t
7Z10480

D1 = BAW62
D2 = diode with minority carrier lifetime at 10 mA: < 200 ps

Reverse pulse: Rise time t_r = 2 ns
Pulse duration t_p = 400 ns
Duty cycle δ = 0.02

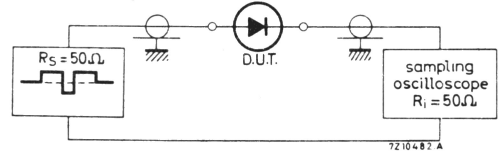
Circuit capacitance $C < 7$ pF (C = Oscilloscope + parasitical capacitance)

CHARACTERISTICS (continued) $T_j = 25\,^{o}C$ unless otherwise specified

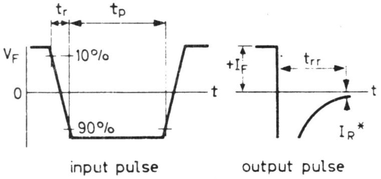
Reverse recovery time when switched from

I_F = 400 mA to I_{RM} = 400 mA; R_L = 100 Ω
measured at I_R = 40 mA t_{rr} < 6 ns

Test circuit:



$R_S = 50\Omega$
D.U.T.
sampling oscilloscope $R_i = 50\Omega$
7Z10482 A



t_r
t_p
V_F
10%
0
t
90%
input pulse
$+I_F$
t_{rr}
t
I_R*
output pulse

*) I_R = 40 mA

Reverse pulse: Rise time t_r = 0.6 ns

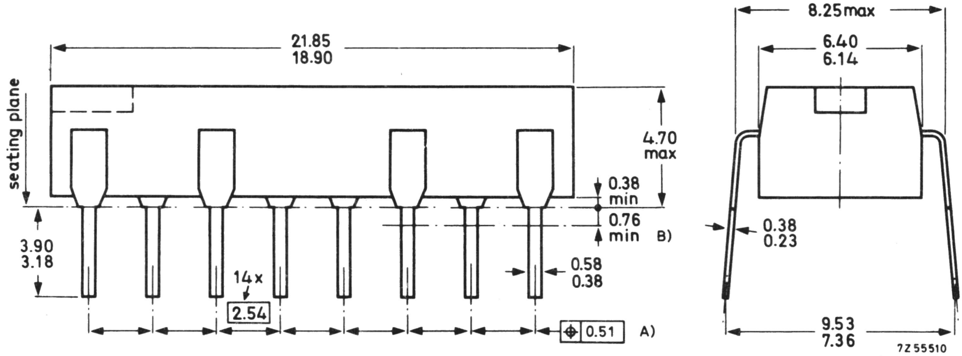
Pulse duration t_p = 100 ns

Duty cycle δ = 0.05

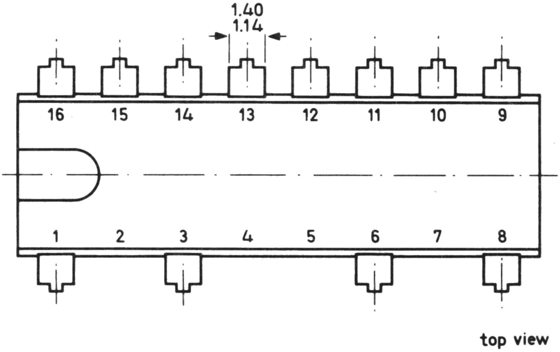
Oscilloscope:

Rise time t_r = 0.35 ns

Circuit capacitance $C \leq 1$ pF (C = Oscilloscope + parasitical capacitance)



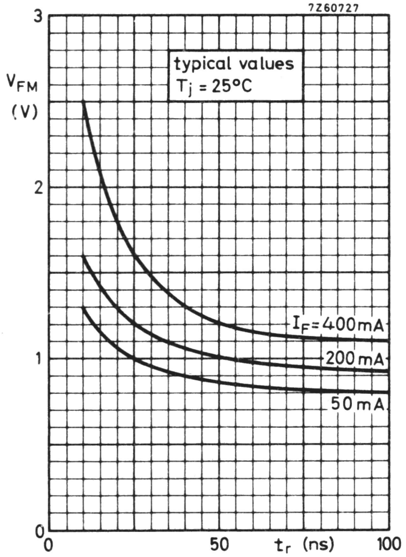
21.85
18.90
seating plane
4.70 max
0.38 min
0.76 min
B)
3.90
3.18
14x
2.54
0.58
0.38
0.51
A)
8.25max
6.40
6.14
0.38
0.23
9.53
7.36
7Z55510

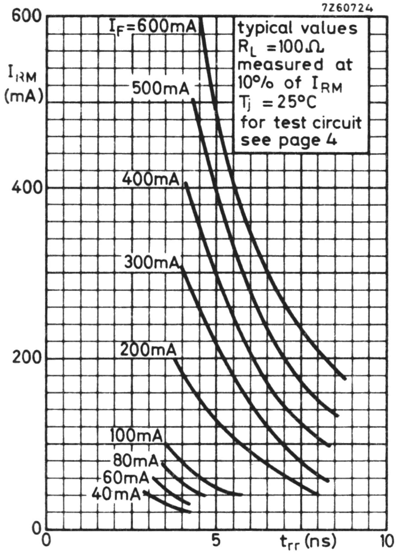


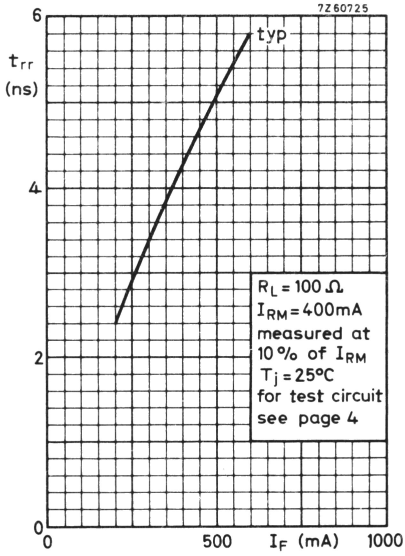
1.40
1.14
16
15
14
13
12
11
10
9
1
2
3
4
5
6
7
8
top view

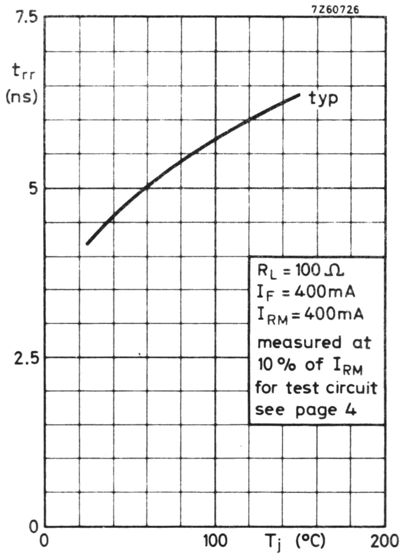
A) Centre-lines of all leads are within ± 0.254 mm of the nominal positions shown; in the worst case, the spacing between any two leads may deviate from nominal by ± 0.51 mm.

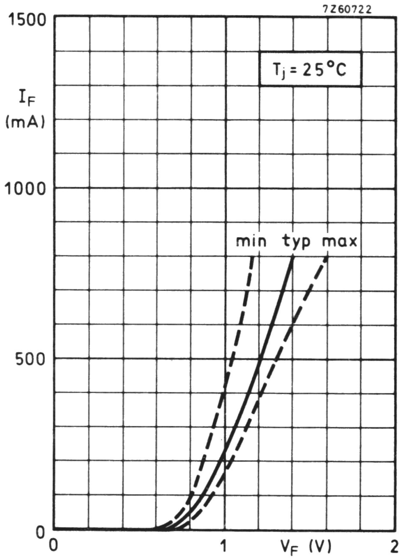
B) Lead spacing tolerances apply from seating plane to the line indicated.

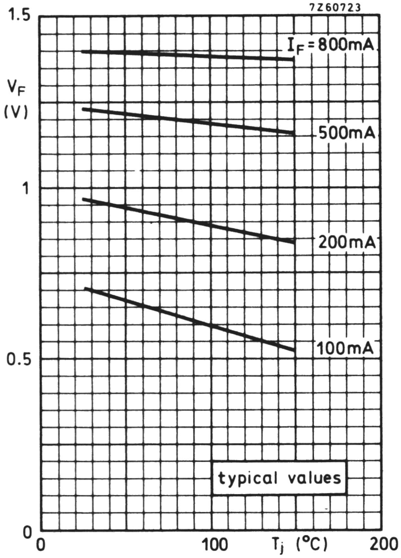

7Z60727
typical values
T_j = 25°C
V_{FM}
(V)
3
2
1
0
I_F=400mA
200mA
50mA
0
50
t_r (ns)
100

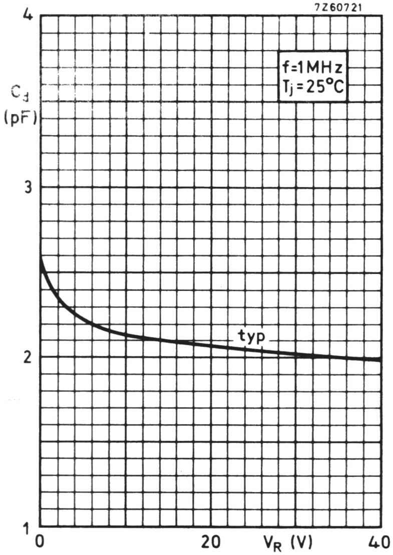

7Z60724
I_{RM}
(mA)
600
400
200
0
I_F=600mA
500mA
400mA
300mA
200mA
100mA
80mA
60mA
40mA
typical values
R_L = 100Ω
measured at
10% of I_{RM}
T_j = 25°C
for test circuit
see page 4
0
5
t_{rr} (ns)
10

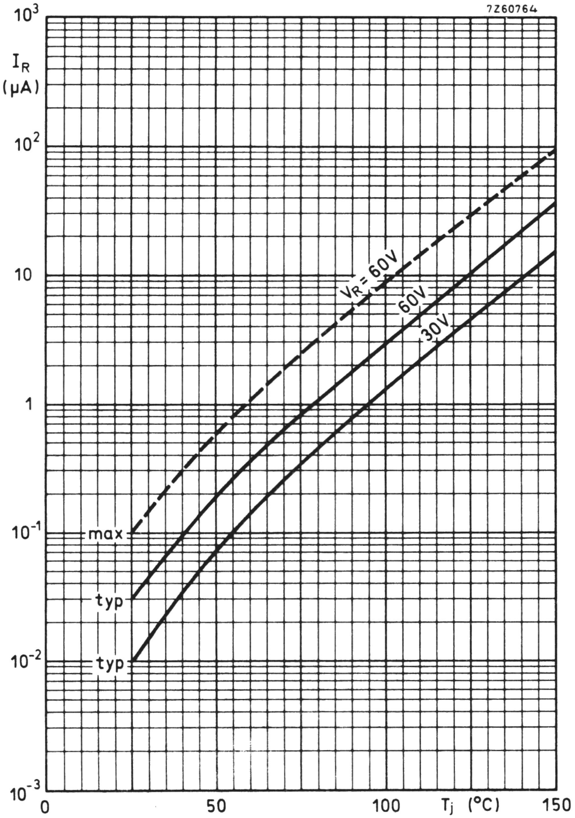

7Z60725
t_{rr}
(ns)
6
4
2
0
typ
R_L = 100 Ω
I_{RM} = 400mA
measured at
10 % of I_{RM}
T_j = 25°C
for test circuit
see page 4
0
500
I_F (mA)
1000


7Z60726
t_{rr}
(ns)
7.5
5
2.5
0
typ
R_L = 100 Ω
I_F = 400mA
I_{RM} = 400mA
measured at
10 % of I_{RM}
for test circuit
see page 4
0
100
T_j (°C)
200


7Z60722
Tj = 25°C
IF
(mA)
1500
1000
500
0
min
typ
max
0
1
VF (V)
2


7Z60723
1.5
1
0.5
0
VF
(V)
IF = 800mA
500mA
200mA
100mA
typical values
0
100
Tj (°C)
200


7Z60721
4
3
2
1
Cd
(pF)
f=1MHz
Tj = 25°C
typ
0
20
VR (V)
40


7Z60764
10^3
I_R
(μA)
10^2
10
1
10^{-1}
10^{-2}
10^{-3}
max
typ
typ
$V_R = 60V$
60V
30V
0
50
100
T_j (°C)
150

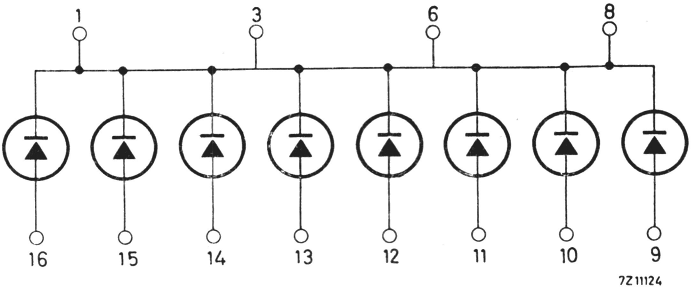
MULTIPLE DIODE

Diode array consisting of 8 silicon planar epitaxial diodes in a plastic DIL envelope. It is intended for core-gating in very fast memories.

QUICK REFERENCE DATA

			Each diode	Total device	
Reverse voltage	V_R	max.	60		V
Repetitive peak reverse voltage	V_{RRM}	max.	60		V
Forward current (d.c.)	I_F	max.	300	1000	mA
Repetitive peak forward current	I_{FRM}	max.	900	2700	mA
Junction temperature	T_j	max.	150	150	°C
Reverse recovery time when switched from I_F = 400 mA to I_{RM} = 400 mA; R_L = 100 Ω; measured at I_R = 40 mA	t_{rr}	<	6		ns

PACKAGE OUTLINE see page 4



RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

INDIVIDUAL DIODE

Voltages

Continuous reverse voltage	V_R	max.	60	V
Repetitive peak reverse voltage	V_{RRM}	max.	60	V

Currents

Forward current d.c.)	I_F	max.	300	mA
Repetitive peak forward current f > 1 MHz	I_{FRM}	max.	600	mA
Repetitive peak forward current pulse repetition frequency (p.r.f.) = 4 MHz $\delta < 0.3$	I_{FRM}	max.	900	mA
Non repetitive peak forward current t < 1 s	I_{FSM}	max.	1000	mA
t < 1 µs	I_{FSM}	max.	4000	mA

Temperatures

Storage temperature	T_{stg}	−55 to	+150	°C
Junction temperature	T_j	max.	150	°C

TOTAL DEVICE Take care not to exceed the individual ratings

Currents

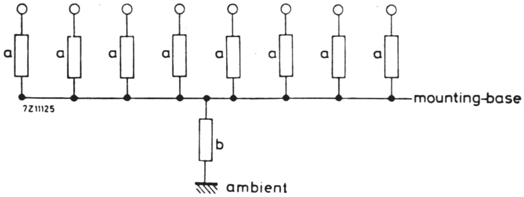
Forward current (d.c.)	I_F	max.	1000	mA
Repetitive peak forward current f > 1 MHz	I_{FRM}	max.	2000	mA
Repetitive peak forward current pulse repetition frequency (p.r.f.) = 4 MHz $\delta < 0.3$	I_{FRM}	max.	2700	mA
Non repetitive peak forward current t < 1 s	I_{FSM}	max.	4000	mA

THERMAL RESISTANCE

From junction to ambient

1 diode dissipating	$R_{th\ j\text{-}a}$	=	280	°C/W
all diodes dissipating	$R_{th\ j\text{-}a}$	=	80	°C/W

The thermal resistance can be replaced by the following equivalent circuit:



The temperature difference between junction and ambient can be found from the relation: $\Delta T_{j\text{-amb}} = P_{sd} \cdot a + P_{tot} \cdot b$

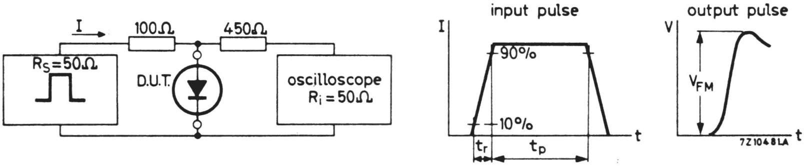
where: P_{sd} = dissipation of a single diode a = 220 °C/W
P_{tot} = dissipating of total device b = 55 °C/W

CHARACTERISTICS

$T_j = 25\ ^oC$ unless otherwise specified

Reverse current				
$V_R = 60$ V	I_R	<	100	nA
$V_R = 60$ V; $T_j = 150\ ^oC$	I_R	<	100	μA
Reverse breakdown voltage; $I_R = 10$ μA	$V_{(BR)R}$	>	75	V
Forward voltage				
$I_F = 10$ mA	V_F	<	750	mV
$I_F = 200$ mA	V_F	<	1050	mV
$I_F = 500$ mA	V_F	>	1035	mV
		<	1300	mV
$I_F = 800$ mA	V_F	<	1600	mV
Diode capacitance				
$V_R = 0$; f = 1 MHz	C_d	<	3	pF
Forward recovery voltage				
$I_F = 400$ mA; $t_r = 30$ ns	V_{FM}	<	2.0	V
$I_F = 400$ mA; $t_r = 100$ ns	V_{FM}	<	1.5	V

Test circuit:


I
100Ω
450Ω
$R_S = 50\Omega$
D.U.T.
oscilloscope
$R_i = 50\Omega$
input pulse
I
90%
10%
t_r
t_p
t
output pulse
V
V_{FM}
t
7Z10481A

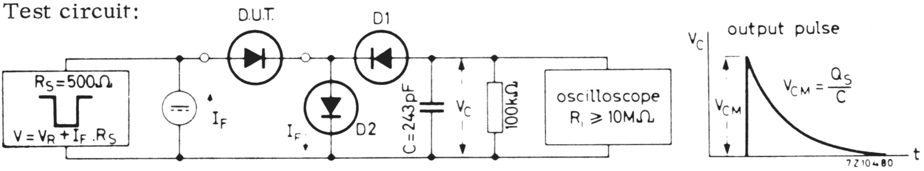
Current pulse: Rise time $t_{r1} = 30$ ns
Rise time $t_{r2} = 100$ ns
Pulse duration $t_p = 300$ ns
Duty cycle $\delta = 0.01$

Oscilloscope:
Rise time $t_r = 0.35$ ns
Input capacitance $C_i \leq 1$ pF

Circuit capacitance $C < 20$ pF (C = Oscilloscope + parasitical capacitance)

Recovered charge when switched from $I_F = 10$ mA to $V_R = 5$ V; $R_L = 500\ \Omega$	Q_s	<	50	pC

Test circuit:


D.U.T.
D1
$R_S = 500\Omega$
$V = V_R + I_F . R_S$
I_F
I_F
D2
C = 243pF
V_C
100kΩ
oscilloscope
$R_i \geq 10M\Omega$
output pulse
V_C
V_{CM}
$V_{CM} = \frac{Q_S}{C}$
t
7Z10480

D1 = BAW62
D2 = diode with minority carrier lifetime at 10 mA: < 200 ps

Reverse pulse: Rise time $t_r = 2$ ns
Pulse duration $t_p = 400$ ns
Duty cycle $\delta = 0.02$

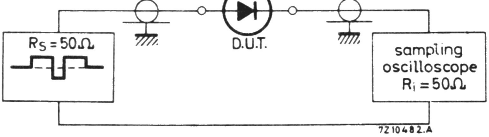
Circuit capacitance $C < 7$ pF (C = Oscilloscope + parasitical capacitance)

CHARACTERISTICS (continued) $T_j = 25\,^{\circ}C$ unless otherwise specified

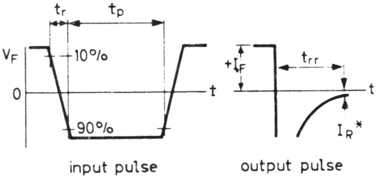
Reverse recovery time when switched from

I_F = 400 mA to I_{RM} = 400 mA; R_L = 100 Ω
measured at I_R = 40 mA t_{rr} < 6 ns

Test circuit:



$R_S = 50\Omega$
D.U.T.
sampling oscilloscope $R_i = 50\Omega$
7Z10482.A



t_r
t_p
V_F
10%
0
t
90%
input pulse
$+I_F$
t_{rr}
t
I_R*
output pulse

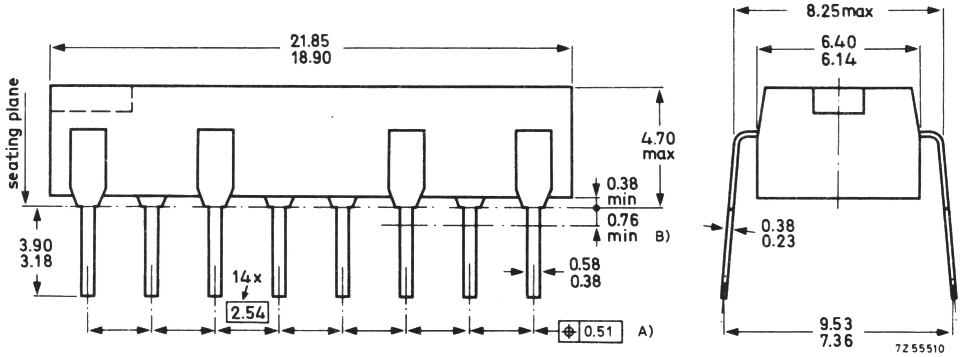
*) I_R = 40 mA

Reverse pulse: Rise time t_r = 0.6 ns Oscilloscope:

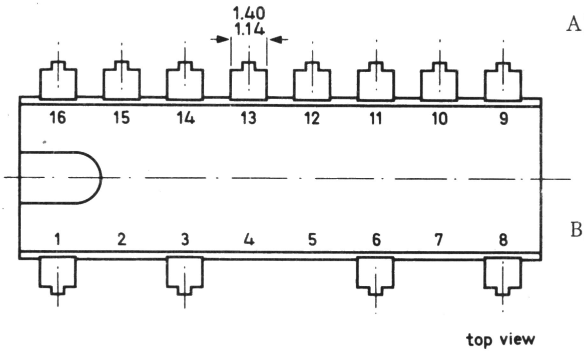
Pulse duration t_p = 100 ns Rise time t_r = 0.35 ns

Duty cycle δ = 0.05

Circuit capacitance $C \leq 1$ pF (C = Oscilloscope + parasitical capacitance)



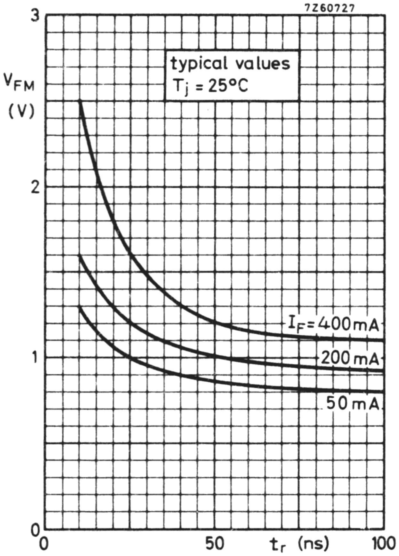
21.85
18.90
seating plane
4.70 max
0.38 min
0.76 min
B)
3.90
3.18
14x
2.54
0.58
0.38
0.51
A)
8.25 max
6.40
6.14
0.38
0.23
9.53
7.36
7Z55510

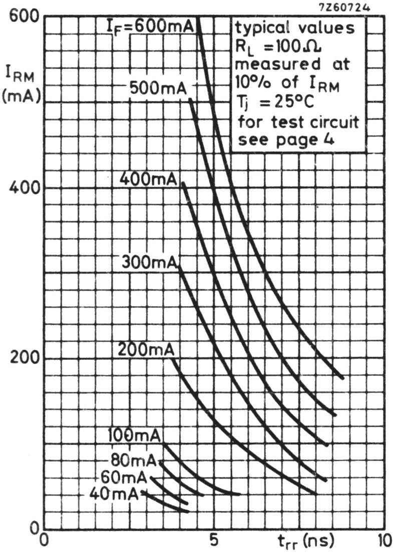


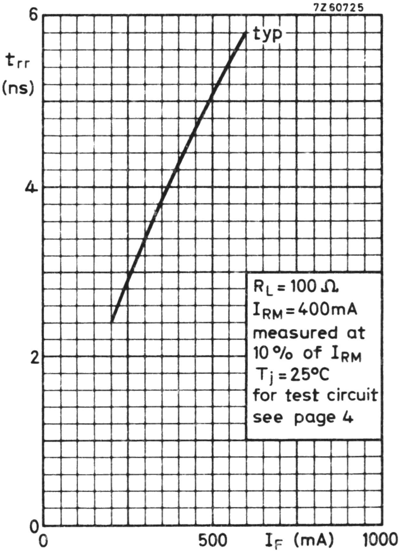
1.40
1.14
16
15
14
13
12
11
10
9
1
2
3
4
5
6
7
8
top view

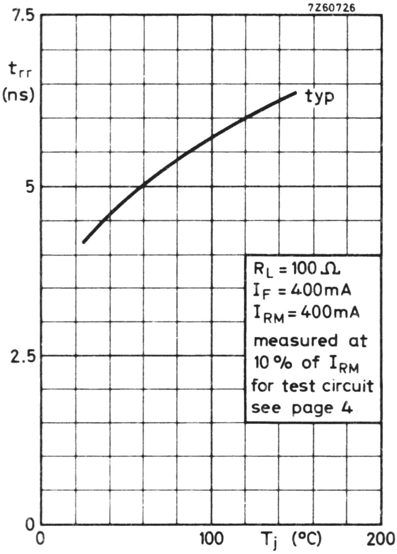
A) Centre-lines of all leads are within ± 0.254 mm of the nominal positions shown; in the worst case, the spacing between any two leads may deviate from nominal by ± 0.51 mm.

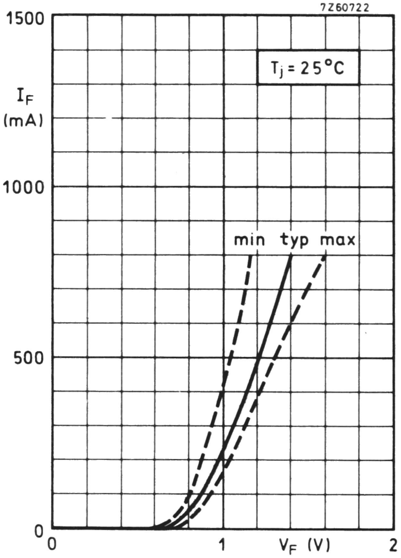
B) Lead spacing tolerances apply from seating plane to the line indicated.

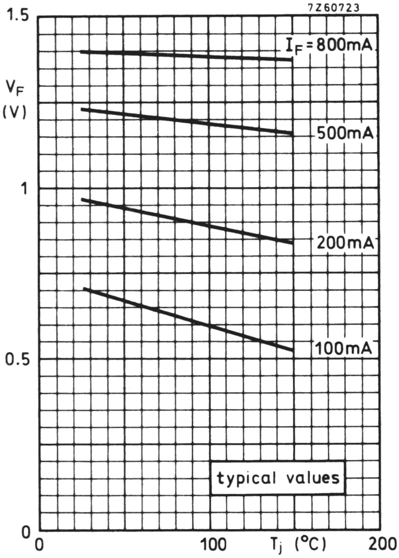

7Z60727
typical values
$T_j = 25°C$
V_{FM}
(V)
3
2
1
0
$I_F = 400 mA$
200 mA
50 mA
0
50
t_r (ns)
100

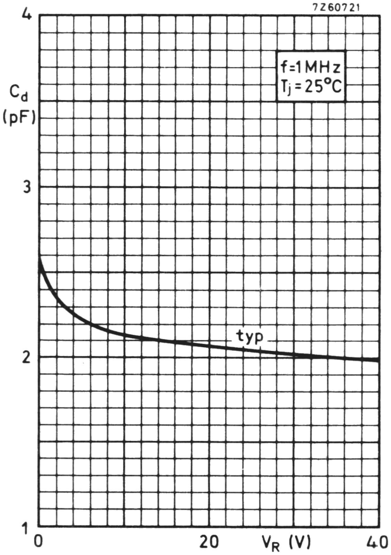

7Z60724
typical values
$R_L = 100 \Omega$
measured at
10% of I_{RM}
$T_j = 25°C$
for test circuit
see page 4
I_{RM}
(mA)
600
400
200
0
$I_F = 600 mA$
500 mA
400 mA
300 mA
200 mA
100 mA
80 mA
60 mA
40 mA
0
5
t_{rr} (ns)
10

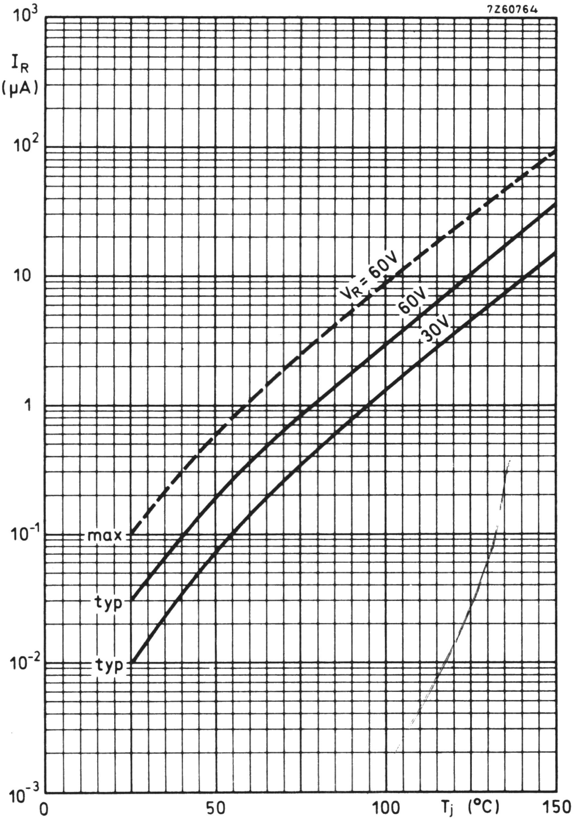

7Z60725
t_{rr}
(ns)
6
4
2
0
typ
$R_L = 100 \Omega$
$I_{RM} = 400 mA$
measured at
10 % of I_{RM}
$T_j = 25°C$
for test circuit
see page 4
0
500
I_F (mA)
1000


7Z60726
t_{rr}
(ns)
7.5
5
2.5
0
typ
$R_L = 100 \Omega$
$I_F = 400 mA$
$I_{RM} = 400 mA$
measured at
10 % of I_{RM}
for test circuit
see page 4
0
100
T_j (°C)
200


7Z60722
1500
1000
500
0
I_F (mA)
$T_j = 25°C$
min typ max
0
1
V_F (V)
2


7Z60723
1.5
1
0.5
0
V_F (V)
I_F = 800mA
500mA
200mA
100mA
typical values
0
100
T_j (°C)
200


7Z60721
4
3
2
1
C_d (pF)
f=1MHz
T_j = 25°C
typ
0
20
V_R (V)
40


7Z60764
10^3
I_R (μA)
10^2
10
1
10^{-1}
10^{-2}
10^{-3}
max
typ
typ
V_R = 60V
60V
30V
0
50
100
T_j (°C)
150

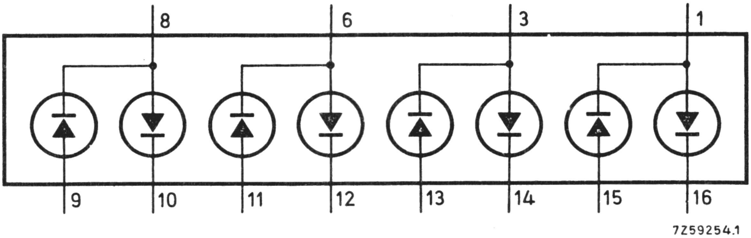
MULTIPLE DIODE

Diode array consisting of 8 silicon planar epitaxial diodes in a plastic DIL envelope. It is intended for core-gating in very fast memories.

QUICK REFERENCE DATA

			Each diode	Total device	
Reverse voltage	V_R	max.	60		V
Repetitive peak reverse voltage	V_{RRM}	max.	60		V
Forward current (d.c.)	I_F	max.	300	1000	mA
Repetitive peak forward current	I_{FRM}	max.	900	2700	mA
Junction temperature	T_j	max.	150	150	°C
Reverse recovery time when switched from I_F = 400 mA to I_{RM} = 400 mA; R_L = 100 Ω; measured at I_R = 40 mA	t_{rr}	<	6		ns

PACKAGE OUTLINE see page 4



RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

INDIVIDUAL DIODE

Voltages

Continuous reverse voltage	V_R	max.	60	V
Repetitive peak reverse voltage	V_{RRM}	max.	60	V

Currents

Forward current (d.c.)	I_F	max.	300	mA
Repetitive peak forward current $f > 1$ MHz	I_{FRM}	max.	600	mA
Repetitive peak forward current pulse repetition frequency (p.r.f.) = 4 MHz $\delta < 0.3$	I_{FRM}	max.	900	mA
Non repetitive peak forward current $t < 1$ s	I_{FSM}	max.	1000	mA
$t < 1$ µs	I_{FSM}	max.	4000	mA

Temperatures

Storage temperature	T_{stg}	−55	to +150	°C
Junction temperature	T_j	max.	150	°C

TOTAL DEVICE Take care not to exceed the individual ratings

Currents

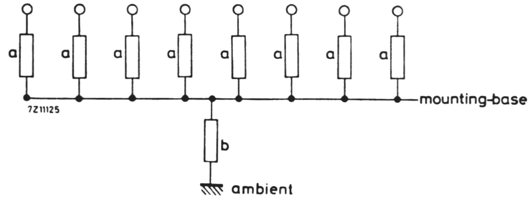
Forward current (d.c.)	I_F	max.	1000	mA
Repetitive peak forward current $f > 1$ MHz	I_{FRM}	max.	2000	mA
Repetitive peak forward current pulse repetition frequency (p.r.f.) = 4 MHz $\delta < 0.3$	I_{FRM}	max.	2700	mA
Non repetitive peak forward current $t < 1$ s	I_{FSM}	max.	4000	mA

THERMAL RESISTANCE

From junction to ambient

1 diode dissipating	$R_{th\ j\text{-}a}$	=	280	°C/W
all diodes dissipating	$R_{th\ j\text{-}a}$	=	80	°C/W

The thermal resistance can be replaced by the following equivalent circuit:



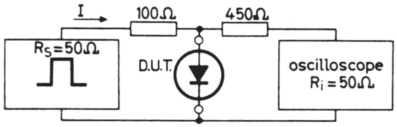
The temperature difference between junction and ambient can be found from the relation: $\Delta T_{j\text{-}amb} = P_{sd} \cdot a + P_{tot} \cdot b$

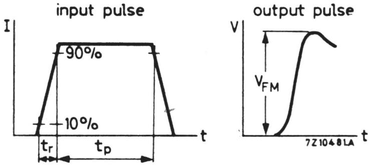
where: P_{sd} = dissipation of a single diode a = 220 °C/W
P_{tot} = dissipation of total device b = 55 °C/W

CHARACTERISTICS $T_j = 25\,^{o}C$ unless otherwise specified

Reverse current				
$V_R = 60$ V	I_R	<	100	nA
$V_R = 60$ V; $T_j = 150\,^{o}C$	I_R	<	100	µA
Reverse breakdown voltage; $I_R = 10$ µA	$V_{(BR)R}$	>	75	V
Forward voltage				
$I_F = 10$ mA	V_F	<	750	mV
$I_F = 200$ mA	V_F	<	1050	mV
$I_F = 500$ mA	V_F	>	1035	mV
		<	1300	mV
$I_F = 800$ mA	V_F	<	1600	mV
Diode capacitance				
$V_R = 0$; f = 1 MHz	C_d	<	3	pF
Forward recovery voltage				
$I_F = 400$ mA; $t_r = 30$ ns	V_{FM}	<	2.0	V
$I_F = 400$ mA; $t_r = 100$ ns	V_{FM}	<	1.5	V

Test circtuit:


I
100Ω
450Ω
R_S=50Ω
D.U.T.
oscilloscope
R_i=50Ω


input pulse
I
90%
10%
t
t_r
t_p
output pulse
V
V_{FM}
t
7Z10481A

Current pulse: Rise time	t_{r1}	=	30 ns
Rise time	t_{r2}	=	100 ns
Pulse duration	t_p	=	300 ns
Duty cycle	δ	=	0.01

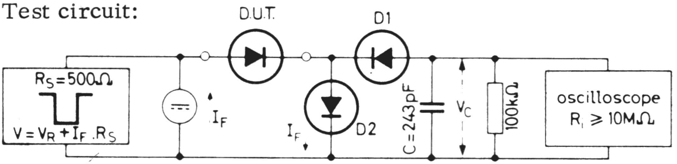
Oscilloscope:

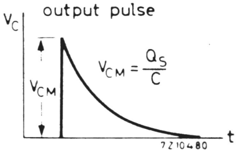
Rise time	t_r	=	0.35 ns
Input capacitance	C_i	≤	1 pF

Circuit capacitance C < 20 pF (C = Oscilloscope + parasitical capacitance)

Recovered charge when switched from				
$I_F = 10$ mA to $V_R = 5$ V; $R_L = 500\ \Omega$	Q_s	<	50	pC

Test circuit:


D.U.T.
D1
R_S=500Ω
$V = V_R + I_F . R_S$
I_F
I_F
D2
C=243pF
V_C
100kΩ
oscilloscope
$R_i \geqslant 10M\Omega$


V_C
output pulse
V_{CM}
$V_{CM} = \frac{Q_S}{C}$
t
7Z10480

D1 = BAW62

D2 = diode with minority carrier lifetime at 10 mA: < 200 ps

Reverse pulse: Rise time	t_r	=	2 ns
Pulse duration	t_p	=	400 ns
Duty cycle	δ	=	0.02

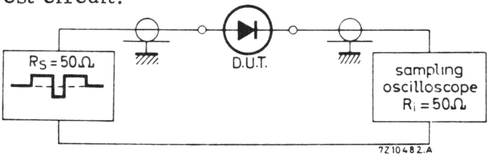
Circuit capacitance C < 7 pF (C = Oscilloscope + parasitical capacitance)

CHARACTERISTICS (continued) $T_j = 25\,^{\circ}C$ unless otherwise specified

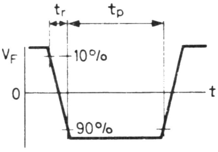
Reverse recovery time when switched from

$I_F = 400$ mA to $I_{RM} = 400$ mA; $R_L = 100\ \Omega$
measured at $I_R = 40$ mA t_{rr} < 6 ns

Test circuit:

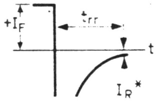


$R_S = 50\Omega$
D.U.T.
sampling oscilloscope $R_i = 50\Omega$
7Z10482.A



t_r
t_p
V_F
10%
0
t
90%

input pulse



output pulse

*) $I_R = 40$ mA

Reverse pulse: Rise time t_r = 0.6 ns

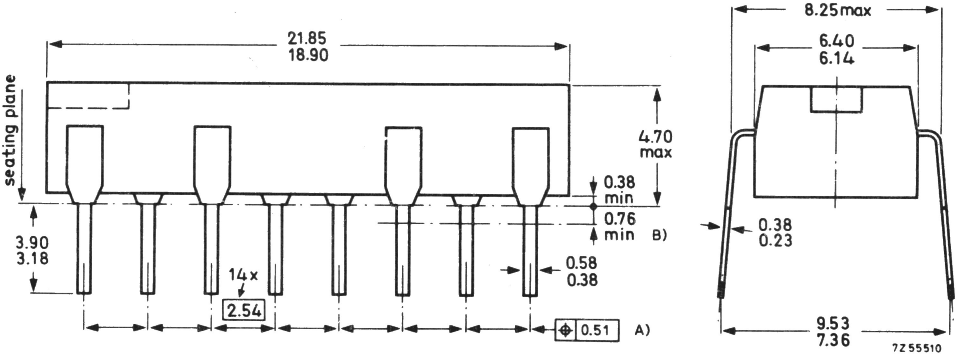
Pulse duration t_p = 100 ns

Duty cycle δ = 0.05

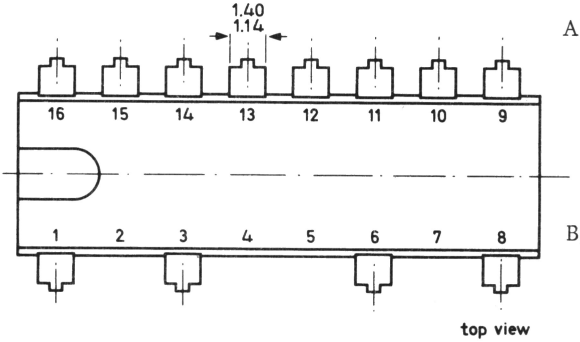
Oscilloscope:

Rise time t_r = 0.35 ns

Circuit capacitance $C \leq 1$ pF (C = Oscilloscope + parasitical capacitance)



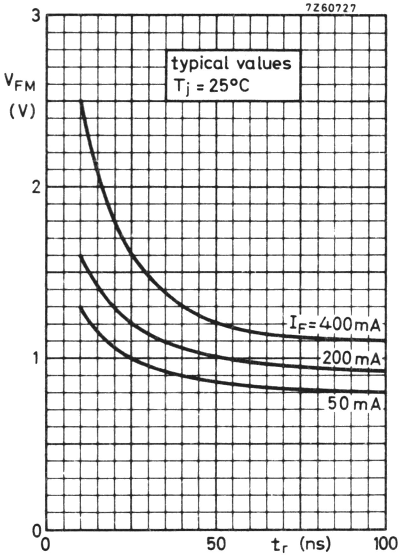
21.85
18.90
seating plane
4.70 max
0.38 min
0.76 min
B)
3.90
3.18
14x
2.54
0.58
0.38
⊕ 0.51
A)
8.25max
6.40
6.14
0.38
0.23
9.53
7.36
7Z55510

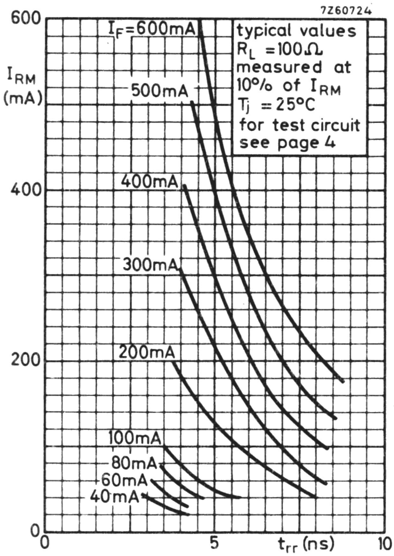


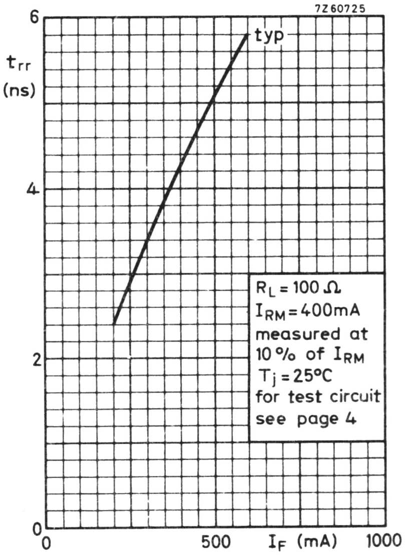
1.40
1.14
16
15
14
13
12
11
10
9
1
2
3
4
5
6
7
8
top view

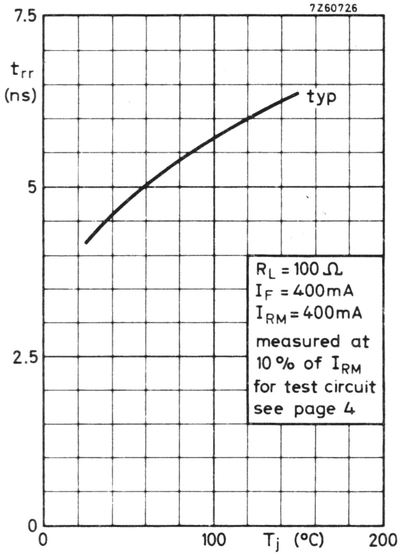
A) Centre-lines of all leads are within ± 0.254 mm of the nominal positions shown; in the worst case, the spacing between any two leads may deviate from nominal by ± 0.51 mm.

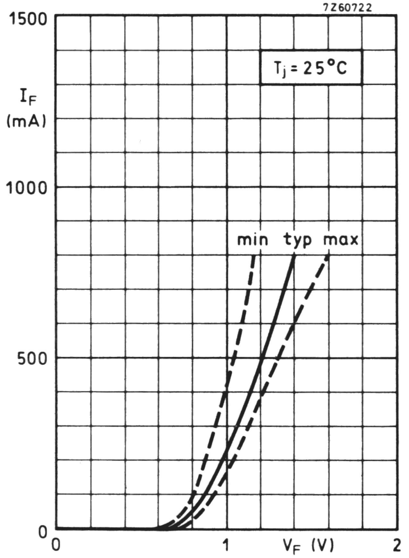
B) Lead spacing tolerances apply form seating plane to the line indicated.

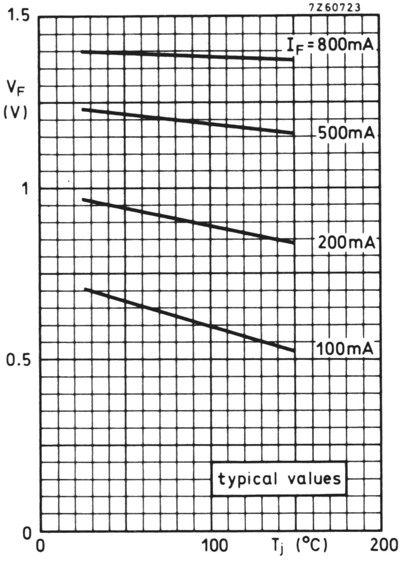

7Z60727
3
2
1
0
V_FM
(V)
typical values
T_j = 25°C
I_F = 400 mA
200 mA
50 mA
0
50
100
t_r (ns)

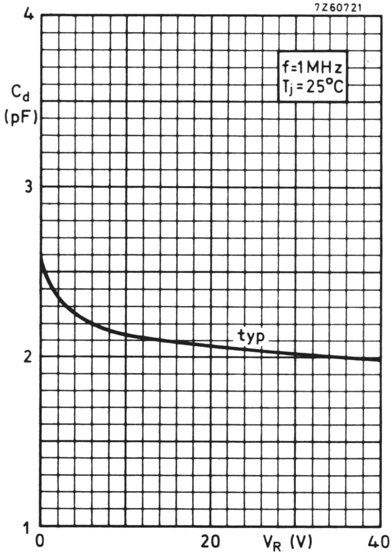

7Z60724
600
400
200
0
I_RM
(mA)
I_F = 600mA
500mA
400mA
300mA
200mA
100mA
80mA
60mA
40mA
typical values
R_L = 100 Ω
measured at
10% of I_RM
T_j = 25°C
for test circuit
see page 4
0
5
10
t_rr (ns)

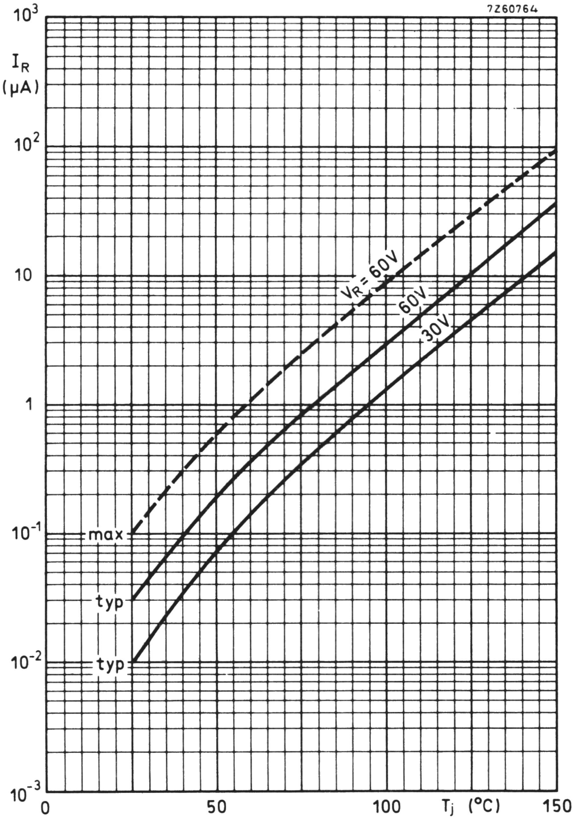

7Z60725
6
4
2
0
t_rr
(ns)
typ
R_L = 100 Ω
I_RM = 400mA
measured at
10 % of I_RM
T_j = 25°C
for test circuit
see page 4
0
500
1000
I_F (mA)


7Z60726
7.5
5
2.5
0
t_rr
(ns)
typ
R_L = 100 Ω
I_F = 400mA
I_RM = 400mA
measured at
10 % of I_RM
for test circuit
see page 4
0
100
200
T_j (°C)


7Z60722
1500
1000
500
0
I_F
(mA)
$T_j = 25°C$
min
typ
max
0
1
V_F (V)
2


7Z60723
1.5
1
0.5
0
V_F
(V)
$I_F = 800mA$
500mA
200mA
100mA
typical values
0
100
T_j (°C)
200


7Z60721
4
3
2
1
C_d
(pF)
f=1MHz
$T_j = 25°C$
typ
0
20
V_R (V)
40


7Z60764
I_R (μA)
10^3
10^2
10
1
10^{-1}
10^{-2}
10^{-3}
max
typ
typ
$V_R = 60V$
60V
30V
0
50
100
T_j (°C)
150

PICOAMPERE DIODE

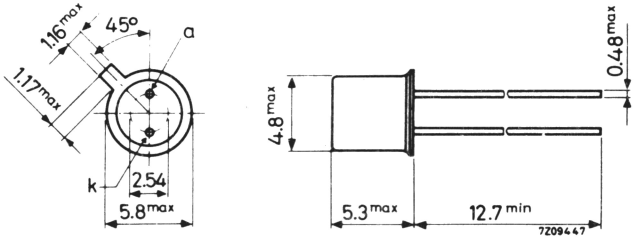
Silicon diode in a metal envelope. It has an extremely low leakage current over a wide temperature range combined with a low capacitance and is not sensitive for light. It is intended for clamping, holding, peak follower, time delay circuits as well as for logarithmic amplifiers and protection of insulated gate field effect transistors.

QUICK REFERENCE DATA

Continuous reverse voltage	V_R	max.	20	V
Forward current (d.c.)	I_F	max.	50	mA
Forward voltage at I_F = 10 mA	V_F	<	1.0	V
Reverse current				
V_R = 5 V; T_j = 25 °C	I_R	<	5	pA
V_R = 20 V; T_j = 25 °C	I_R	<	10	pA
Diode capacitance				
V_R = 0; f = 1 MHz	C_d	<	1.3	pF

MECHANICAL DATA

Dimensions in mm



Handle the device with care during soldering into the circuit. The extremely low leakage current can only be guaranteed when the bottom is free from solder flux or other contaminations.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

Continuous reverse voltage	V_R	max.	20	V
Repetitive peak reverse voltage	V_{RRM}	max.	35	V

Currents

Forward current (d.c. or average)	I_F	max.	50	mA
Repetitive peak forward current	I_{FRM}	max.	100	mA

Temperatures

Storage temperature	T_{stg}	−65 to	+125	°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.5	°C/mW

CHARACTERISTICS $T_j = 25\ ^{\circ}C$ unless otherwise specified

Forward voltage

$I_F = 10$ mA	V_F	<	1.0	V

Reverse currents

$V_R = 5$ V	I_R	<	5	pA
$V_R = 5$ V; $T_j = 80\ ^{\circ}C$	I_R	<	250	pA
$V_R = 20$ V	I_R	<	10	pA

Diode capacitance

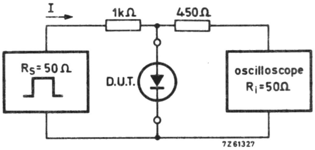
$V_R = 0$; f = 1 MHz	C_d	<	1.3	pF

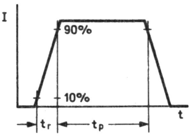
CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

Forward recovery voltage when switched to

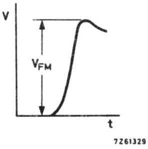
I_F = 10 mA V_{FM} < 1.25 V

Test circuit:


I
1kΩ
450Ω
R_S=50Ω
D.U.T.
oscilloscope
R_i=50Ω
7Z61327


I
90%
10%
t
t_r
t_p

input pulse


V
V_{FM}
t
7Z61329

output pulse

Current pulse: Rise time $t_r \leq$ 20 ns Oscilloscope:

Pulse duration t_p = 300 ns Rise time t_r = 0.35 ns

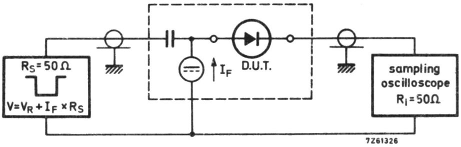
Duty cycle δ = 0.01 Input capacitance $C_i \leq$ 1 pF

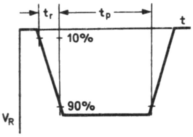
Circuit capacitance $C \leq$ 20 pF (C = Oscilloscope + parasitical capacitance)

Reverse recovery time when switched from

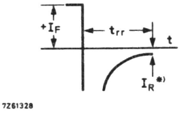
I_F = 10 mA to V_R = 1 V; R_L = 100 Ω; I_{RM} = 10 mA
measured at I_R = 1 mA t_{rr} < 350 ns

Test circuit:


R_S=50Ω
$V=V_R+I_F \times R_S$
I_F
D.U.T.
sampling
oscilloscope
R_i=50Ω
7Z61326


t_r
t_p
t
10%
90%
V_R

input pulse


$+I_F$
t_{rr}
t
I_R*)
7Z61328

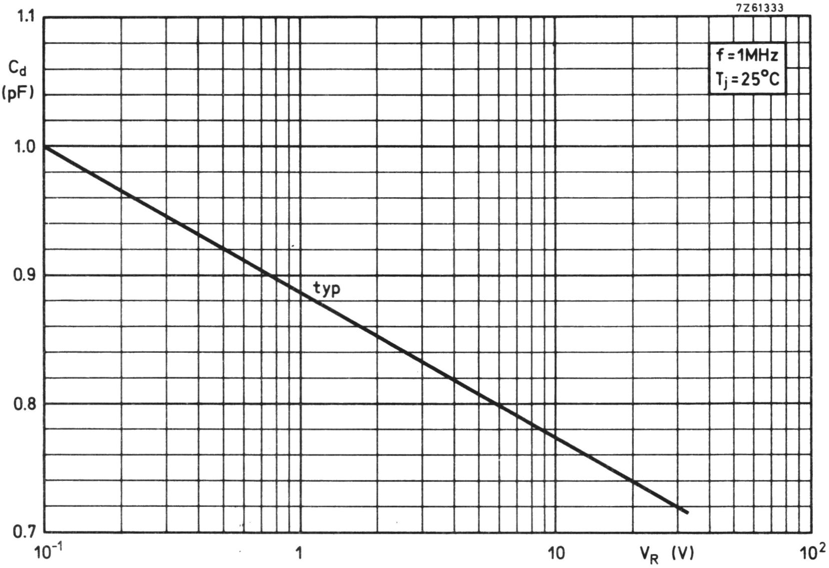
output pulse

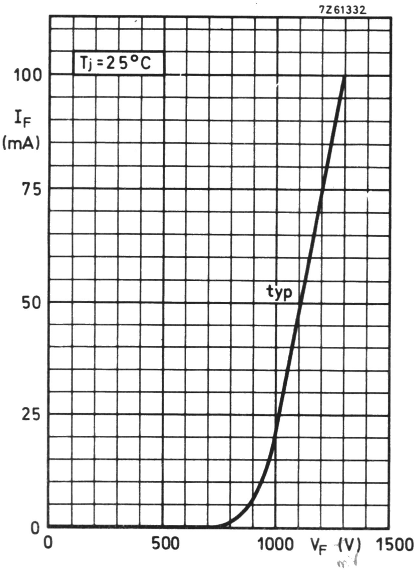
Reverse pulse: Rise time $t_r \leq$ 20 ns Oscilloscope: *) I_R = 1 mA

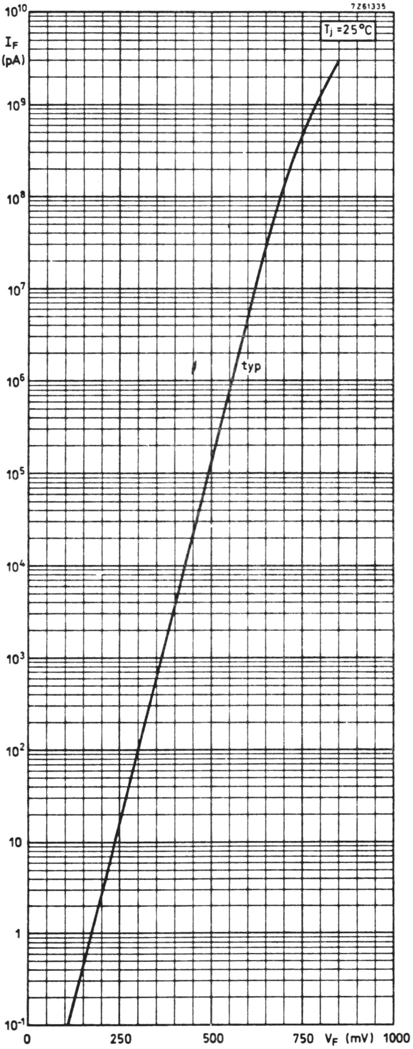
Pulse duration t_p = 500 ns Rise time t_r = 0.35 ns

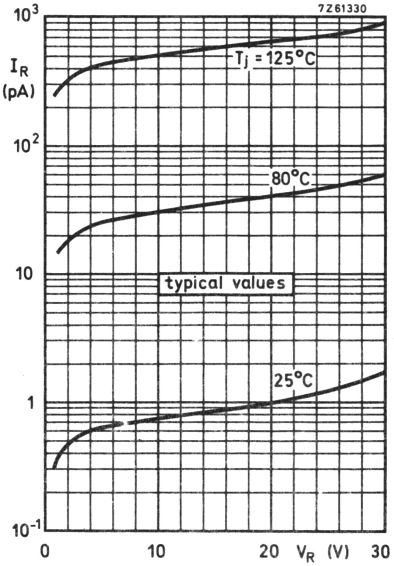
Duty cycle δ = 0.05

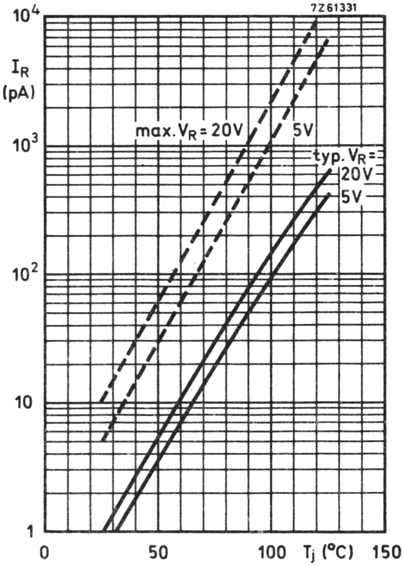
Circuit capacitance $C \leq$ 1 pF (C = Oscilloscope + parasitical capacitance)


7Z61333
1.1
C_d
(pF)
1.0
0.9
0.8
0.7
f = 1MHz
T_j = 25°C
typ
10^{-1}
1
10
V_R (V)
10^2


7Z61332
T_j = 25°C
100
I_F
(mA)
75
50
25
0
typ
0
500
1000
V_F (V)
1500
mV


7Z61335
T_j = 25 °C
I_F
(pA)
10^{10}
10^9
10^8
10^7
10^6
10^5
10^4
10^3
10^2
10
1
10^{-1}
typ
0
250
500
750
V_F (mV)
1000


7Z61330
10^3
I_R
(pA)
T_j = 125°C
10^2
80°C
10
typical values
1
25°C
10^{-1}
0
10
20
V_R (V)
30


7Z61331
10^4
I_R
(pA)
max. V_R = 20V
5V
10^3
typ. V_R =
20V
5V
10^2
10
1
0
50
100
T_j (°C)
150

HIGH SPEED SILICON DIODES

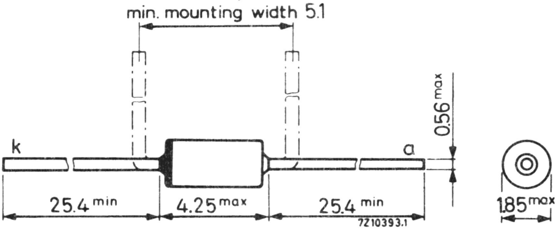
Silicon planar epitaxial high speed diode in a DO-35 envelope.
The BAW62 is primarily intended for fast logic applications.

QUICK REFERENCE DATA

Continuous reverse voltage	V_R	max.	75	V
Repetitive peak reverse voltage	V_{RRM}	max.	75	V
Repetitive peak forward current	I_{FRM}	max.	225	mA
Junction temperature	T_j	max.	200	^oC
Forward voltage at I_F = 100 mA	V_F	<	1	V
Reverse recovery time when switched from I_F = 10 mA to V_R = 1 V; R_L = 100 Ω				
measured at I_R = 1 mA	t_{rr}	<	4	ns

MECHANICAL DATA Dimensions in mm

DO-35


min. mounting width 5.1
k
a
0.56 max
25.4 min
4.25 max
25.4 min
7Z10393.1
1.85 max

Cathode indicated by coloured mark or by broad band if colour coded (see General Section)

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages				
Continuous reverse voltage	V_R	max.	75	V
Repetitive peak reverse voltage	V_{RRM}	max.	75	V [1]
Currents				
Average rectified forward current	I_{FAV}	max.	100	mA [2]
Forward current (d.c.)	I_F	max.	100	mA
Repetitive peak forward current	I_{FRM}	max.	225	mA
Non repetitive peak forward current t = 1 μs	I_{FSM}	max.	2000	mA
t = 1 s	I_{FSM}	max.	500	mA
Temperatures				
Storage temperature	T_{stg}	-65 to +200		°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air at maximum lead length	$R_{th\ j\text{-}a}$	=	0.6	°C/mW

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Forward voltages				
I_F = 5 mA	V_F	0.62 to 0.75		V
I_F = 100 mA	V_F	<	1	V
I_F = 100 mA; T_j = 100 °C	V_F	<	0.93	V
Reverse currents				
V_R = 20 V	I_R	<	25	nA
V_R = 20 V; T_j = 150 °C	I_R	<	50	μA
V_R = 75 V	I_R	<	5	μA
V_R = 75 V; T_j = 150 °C	I_R	<	100	μA
Diode capacitance				
V_R = 0; f = 1 MHz	C_d	<	2	pF

---

1) Measured at zero lifetime at I_R = 100 μA; V_R > 100 V.

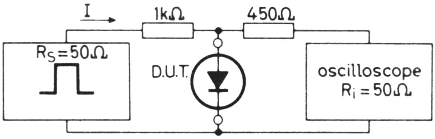
2) For sinusoidal operation see page 6. For pulse operation see page 5.

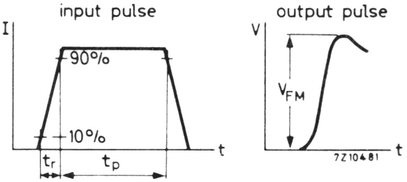
CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

Forward recovery voltage when switched to

I_F = 50 mA; t_r = 20 ns V_{FM} < 2.5 V

Test circuit:


I
1kΩ
450Ω
R_S=50Ω
D.U.T.
oscilloscope
R_i=50Ω


input pulse
I
90%
10%
t
t_r
t_p
output pulse
V
V_{FM}
t
7Z10481

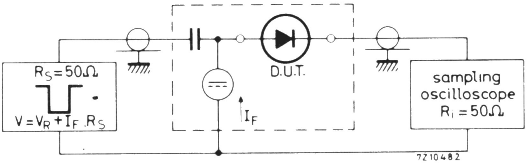
Current pulse: Rise time	t_r = 20 ns	Oscilloscope:	
Pulse duration	t_p = 120 ns	Rise time	t_r = 0.35 ns
Duty cycle	δ = 0.01		

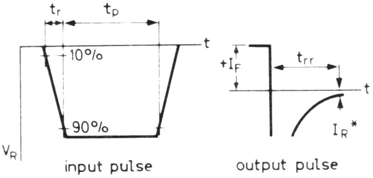
Circuit capacitance $C \leq 1$ pF (C = Oscilloscope + parasitical capacitance)

Reverse recovery time when switched from

I_F = 10 mA to V_R = 1 V; R_L = 100 Ω
measured at I_R = 1 mA t_{rr} < 4 ns

Test circuit:


R_S=50Ω
$V = V_R + I_F.R_S$
D.U.T.
I_F
sampling
oscilloscope
R_i=50Ω
7Z10482


t_r
t_p
t
10%
90%
V_R
input pulse
$+I_F$
t_{rr}
t
I_R*
output pulse

*) I_R = 1 mA

Reverse pulse: Rise time	t_r = 0.6 ns	Oscilloscope:	
Pulse duration	t_p = 100 ns	Rise time	t_r = 0.35 ns
Duty cycle	δ = 0.05		

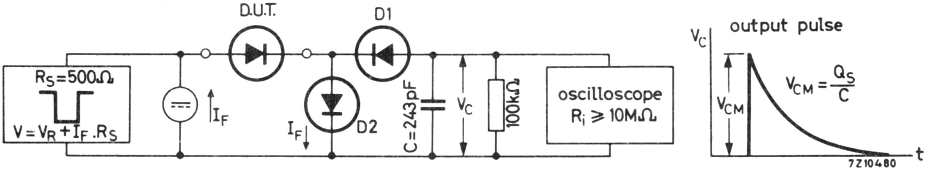
Circuit capacitance $C \leq 1$ pF (C = Oscilloscope + parasitical capacitance)

CHARACTERISTICS (continued)

Recovered charge when switched from

I_F = 10 mA to V_R = 5 V; R_L = 500 Ω | Q_s typ. 50 pC

Test circuit


D.U.T.
D1
$R_S = 500\Omega$
$V = V_R + I_F . R_S$
I_F
I_F
D2
C=243pF
V_C
100kΩ
oscilloscope
$R_i \geq 10M\Omega$
V_C
output pulse
V_{CM}
$V_{CM} = \frac{Q_S}{C}$
t
7Z10480

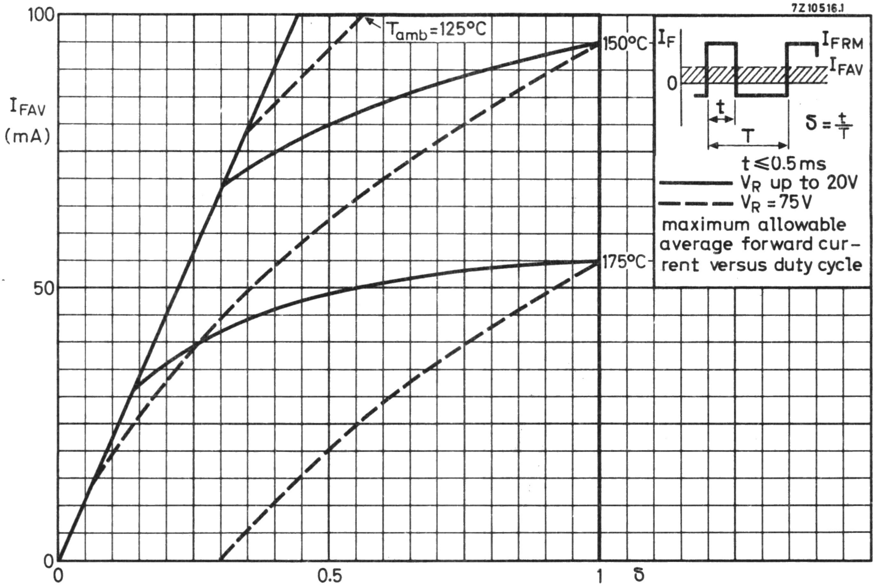
D1 = D2 = BAW62

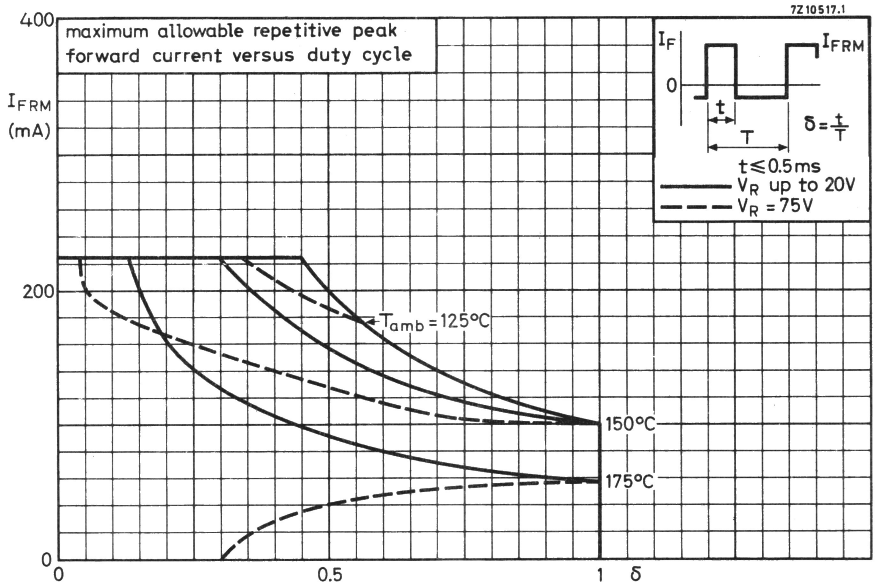
Reverse pulse: Rise time t_r = 2 ns

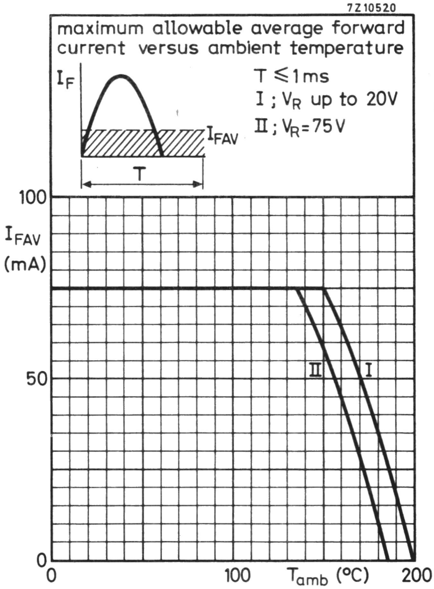
Pulse duration t_p = 400 ns

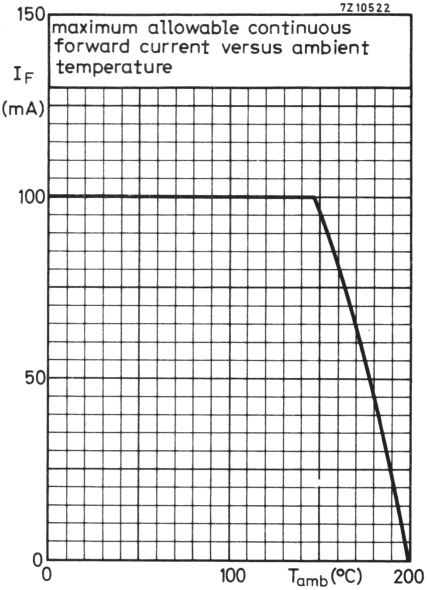
Duty cycle δ = 0.02

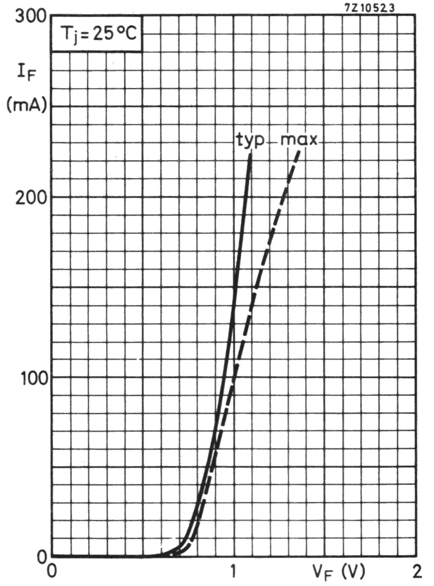
Circuit capacitance $C \leq 7$ pF (C = Oscilloscope + parasitical capacitance)

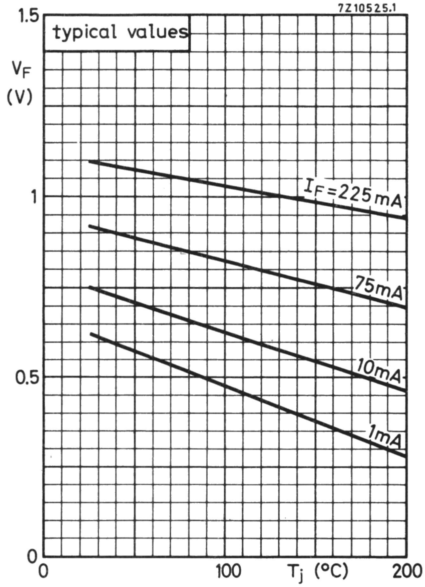

7Z10516.1
100
50
0
I_{FAV}
(mA)
0
0.5
1
δ
T_{amb} = 125°C
150°C
175°C
I_F
I_{FRM}
I_{FAV}
0
t
T
δ = $\frac{t}{T}$
t ≤ 0.5 ms
V_R up to 20V
V_R = 75V
maximum allowable average forward current versus duty cycle

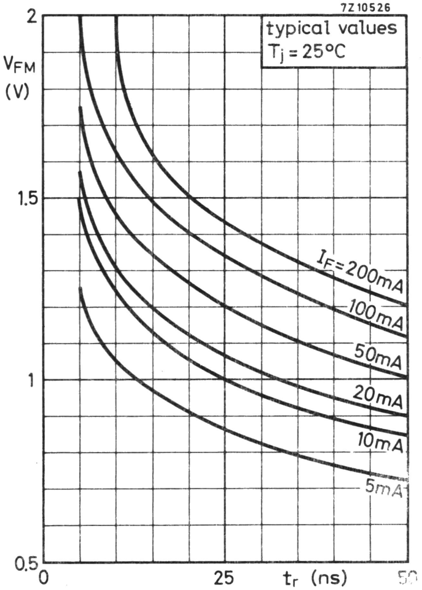

7Z10517.1
400
200
0
I_{FRM}
(mA)
0
0.5
1
δ
maximum allowable repetitive peak forward current versus duty cycle
T_{amb} = 125°C
150°C
175°C
I_F
I_{FRM}
0
t
T
δ = $\frac{t}{T}$
t ≤ 0.5 ms
V_R up to 20V
V_R = 75V

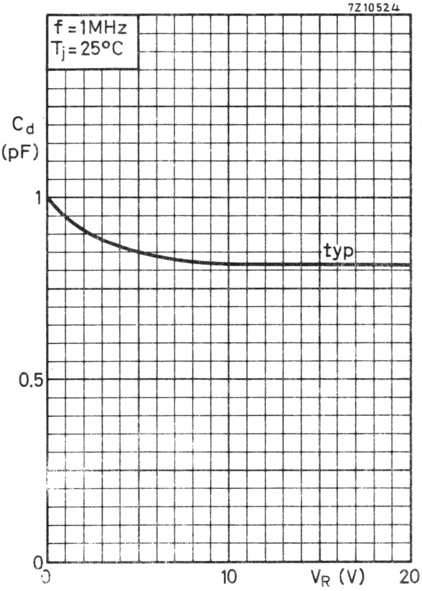

7Z10520
maximum allowable average forward current versus ambient temperature
I_F
I_{FAV}
T
$T \leqslant 1$ ms
I ; V_R up to 20V
II ; V_R = 75 V
100
I_{FAV}
(mA)
50
0
0
100
T_{amb} (°C)
200
II
I

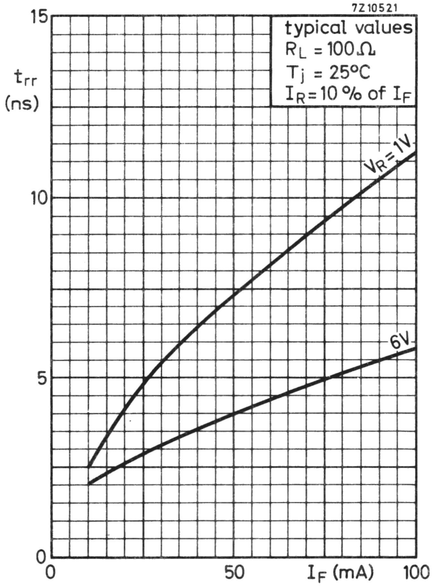

7Z10522
maximum allowable continuous forward current versus ambient temperature
150
I_F
(mA)
100
50
0
0
100
T_{amb} (°C)
200

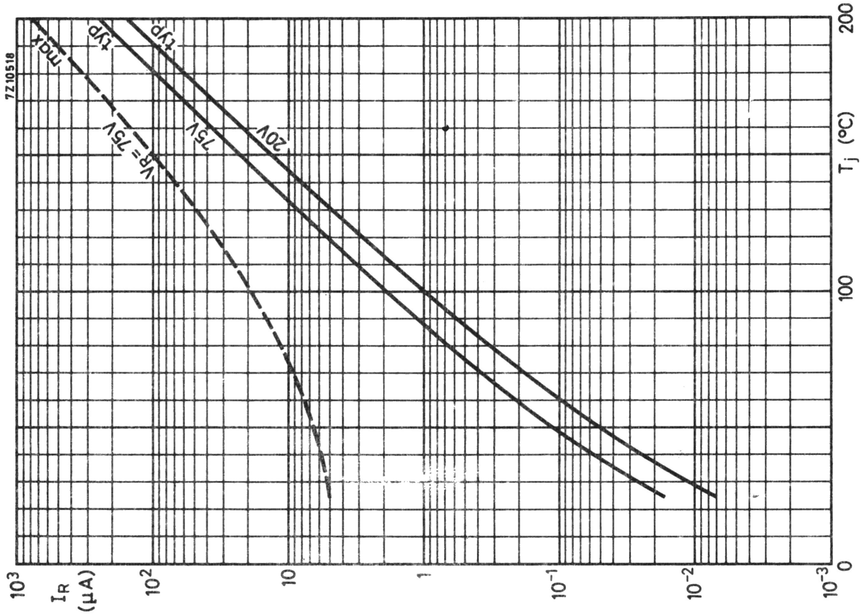

7Z10523
T_j = 25 °C
300
I_F
(mA)
200
100
0
typ
max
0
1
V_F (V)
2

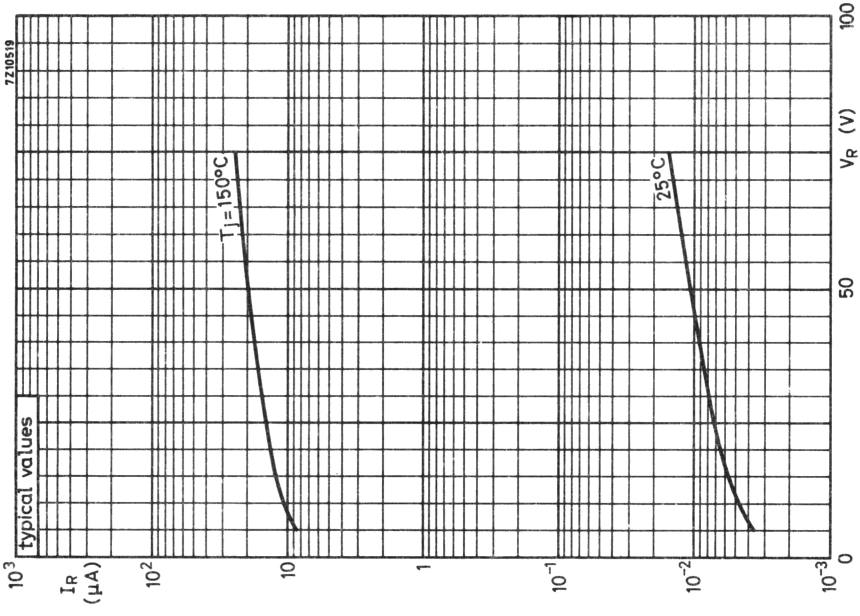

7Z10525.1
typical values
1.5
V_F
(V)
1
0.5
0
I_F = 225 mA
75mA
10mA
1mA
0
100
T_j (°C)
200


7Z10526
typical values
$T_j = 25°C$
V_{FM}
(V)
2
1.5
1
0.5
0
25
t_r (ns)
50
$I_F = 200mA$
100mA
50mA
20mA
10mA
5mA


7Z10524
f = 1MHz
$T_j = 25°C$
C_d
(pF)
1
0.5
0
typ
0
10
V_R (V)
20


7Z10521
typical values
$R_L = 100\Omega$
$T_j = 25°C$
$I_R = 10\%$ of I_F
t_{rr}
(ns)
15
10
5
0
$V_R = 1V$
6V
0
50
I_F (mA)
100


7Z10518
max
typ
typ
$V_R = 75V$
75V
20V
I_R (μA)
10^3
10^2
10
1
10^{-1}
10^{-2}
10^{-3}
T_j (°C)
0
100
200

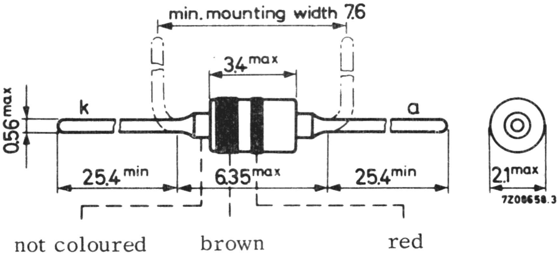

7Z10519
typical values
$T_j = 150°C$
25°C
I_R (μA)
10^3
10^2
10
1
10^{-1}
10^{-2}
10^{-3}
V_R (V)
0
50
100

SILICON OXIDE PASSIVATED AVALANCHE DIODE

Whiskerless diffused diode in a molybdenum hard glass subminiature envelope, capable of absorbing transients repetitively. It is a fast high conductance diode, primarily intended for switching inductive loads in semi-electronic telephone exchanges.

QUICK REFERENCE DATA				
Repetitive peak forward current	I_{FRM}	max.	800	mA
Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	0.3	°C/mW
Forward voltage at I_F = 200 mA	V_F	<	1.0	V
Reverse breakdown voltage I_R = 1 mA	$V_{(BR)R}$	120 to 175		V
Reverse recovery time when switched from I_F = 30 mA to V_R = 3 V; R_L = 100 Ω measured at I_R = 3 mA	t_{rr}	<	50	ns
Recovered charge when switched from I_F = 10 mA to V_R = 5 V R_L = 500 Ω	Q_s	<	0.5	nC

MECHANICAL DATA Dimensions in mm


min. mounting width 7.6
3.4max
0.56max
k
a
25.4min
6.35max
25.4min
2.1max
7Z08658.3
not coloured
brown
red

RATINGS (Limiting values) [1]

Voltage

Continuous reverse voltage	V_R	max.	90	V [2]

Currents

Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	400	mA
Forward current (d.c.)	I_F	max.	400	mA
Repetitive peak forward current	I_{FRM}	max.	800	mA
Non repetitive peak forward current				
t = 1 μs	I_{FSM}	max.	6000	mA
t = 1 s	I_{FSM}	max.	1500	mA
Repetitive peak reverse current	I_{RRM}	max.	600	mA

Temperatures

Storage temperature	T_{stg}		-65 to +200	°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	0.3	°C/mW

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Forward voltage

I_F = 10 mA	V_F	<	0.75	V
I_F = 50 mA	V_F	<	0.84	V
I_F = 100 mA	V_F	<	0.90	V
I_F = 200 mA	V_F	<	1.0	V
I_F = 400 mA	V_F	<	1.25	V

Reverse breakdown voltage

I_R = 1 mA	$V_{BR(R)}$	120 to	175	V

Reverse current

V_R = 90 V; T_j = 150 °C	I_R	<	100	μA

Diode capacitance

V_R = 0; f = 1 MHz	C_d	typ.	25	pF
		<	35	pF

---

[1] Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

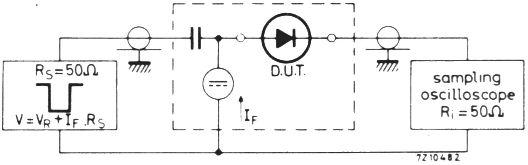
[2] It is allowed to exceed this value as described on page 4. Care should be taken not to exceed the I_{RRM} rating.

CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

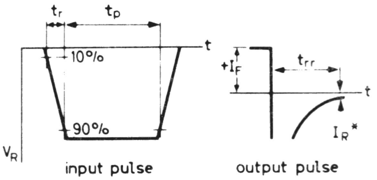
Reverse recovery time when switched from

I_F = 30 mA to V_R = 3 V; R_L = 100 Ω measured at I_R = 1 mA	t_{rr}	typ. <	37 60	ns ns
measured at I_R = 3 mA	t_{rr}	typ. <	30 50	ns ns

Test circuit:



$R_S = 50\Omega$
$V = V_R + I_F.R_S$
D.U.T.
I_F
sampling oscilloscope $R_i = 50\Omega$
7Z10482



t_r
t_p
t
10%
90%
V_R
input pulse
$+I_F$
t_{rr}
t
I_R*
output pulse

*) I_R = 1 mA (resp. 3 mA)

Reverse pulse: Rise time t_r = 0.6 ns

Pulse duration t_p = 100 ns

Duty cycle δ = 0.05

Oscilloscope:

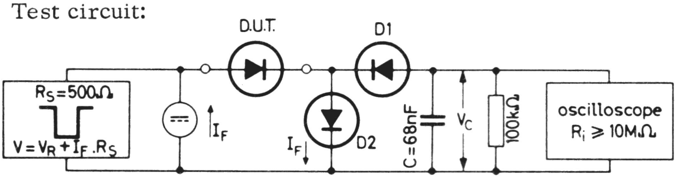
Rise time t_r = 0.35 ns

Circuit capacitance $C \leq 1$ pF (C = Oscilloscope + parasitical capacitance)

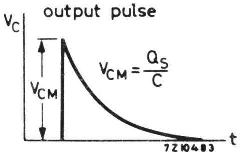
Recovered charge when switched from

I_F = 10 mA to V_R = 5 V; R_L = 500 Ω Q_s < 0.5 nC

Test circuit:



D.U.T.
D1
$R_S = 500\Omega$
$V = V_R + I_F.R_S$
I_F
I_F
D2
C=68nF
V_C
100kΩ
oscilloscope $R_i \geqslant 10M\Omega$



V_C
output pulse
V_{CM}
$V_{CM} = \frac{Q_S}{C}$
t
7Z10483

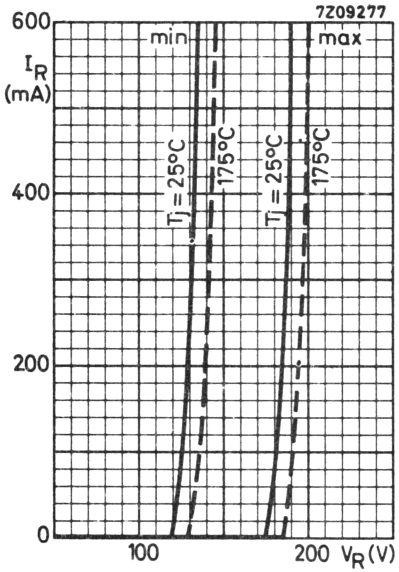
D1 = D2 = BAW62

Reverse pulse: Rise time t_r = 15 ns

Pulse duration t_p = 35 μs

Frequency f = 25 kHz

Circuit capacitance $C < 30$ pF (C = Oscilloscope + parasitical capacitance)

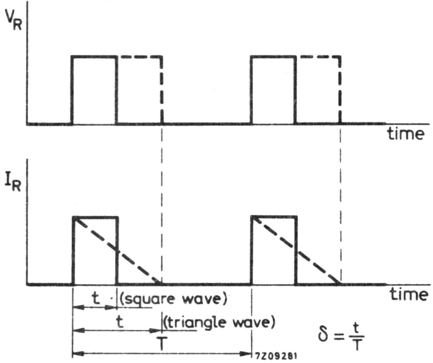


Reverse voltages higher than the V_R ratings are allowed, provided

a. the transient energy ≤ 5 mWs at $T_j = 25\,^{o}C$

b. $T \geq 50$ ms: $\delta \leq 0.01$ (square wave pulse)
$\delta \leq 0.02$ (triangle wave pulse)

With increasing temperature, the maximum allowable transient energy must be decreased by 0.015 mWs/°C.



EXAMPLE for calculating the maximum allowable drive current and the maximum turn off time in a practical circuit (see fig. 1)

1. Maximum allowable drive current

For the circuit shown it can be calculated with $E = \frac{1}{2} LI^2$

$$I_{drive\ max.} = \sqrt{\frac{5 \times 10^{-3}}{\frac{1}{2} \times 0.6}} = 130 \text{ mA}$$

2. Maximum turn off time

Immediately after opening switch S the reverse current of the diode is $I_R = I_{drive}$

The turn off time $t_{off} = \frac{E}{\frac{1}{2} \times I_R \times V_{(BR)R}}$. It will be maximum for devices with minimum breakdown voltage if the maximum drive current is applied.

Hence $t_{off\ max.} = \frac{5 \times 10^{-3}}{\frac{1}{2} \times 130 \times 10^{-3} \times 120} = 0.6$ ms

For $I_{drive} = 100$ mA: $t_{off\ max} = \frac{\frac{1}{2} \times 0.6 \times 10^{-2}}{\frac{1}{2} \times 100 \times 10^{-3} \times 120} = 0.5$ ms

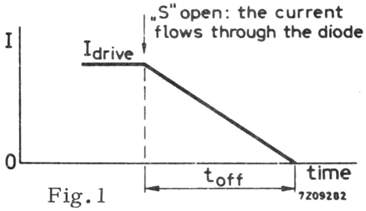


Fig. 1

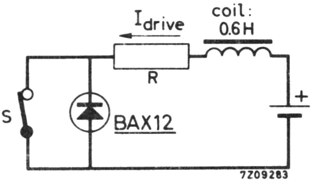
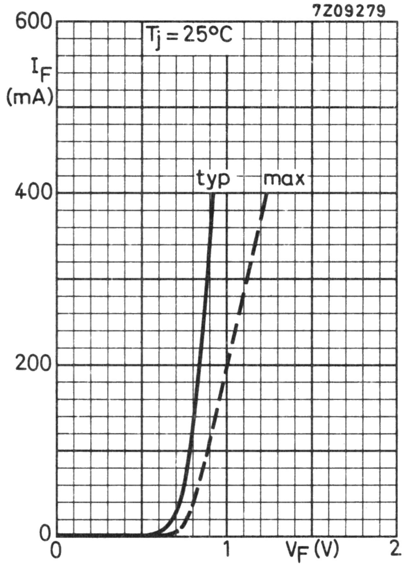
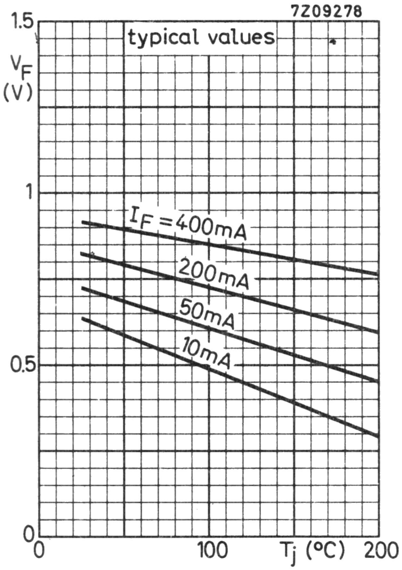
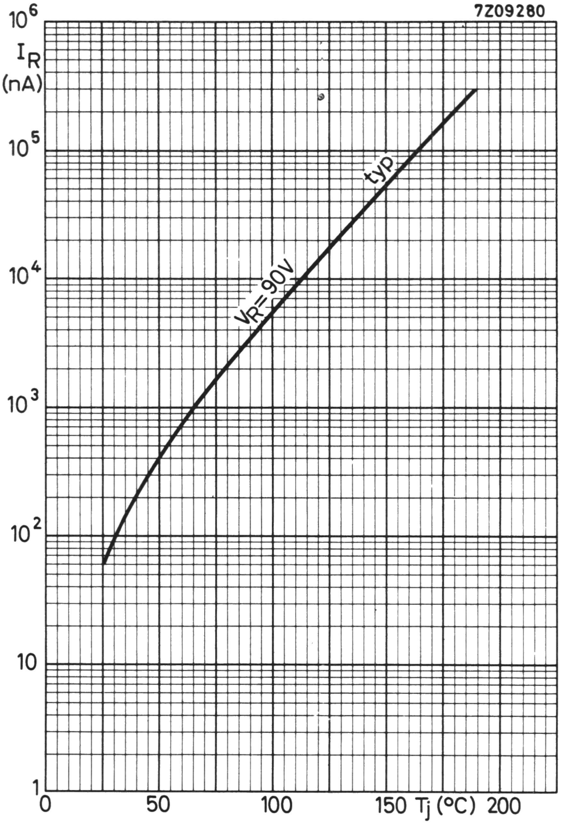


Fig. 2


7Z09279
$T_j = 25°C$
I_F (mA)
600
400
200
0
typ
max
0
1
V_F (V)
2


7Z09278
typical values
V_F (V)
1.5
1
0.5
0
I_F = 400mA
200mA
50mA
10mA
0
100
T_j (°C)
200

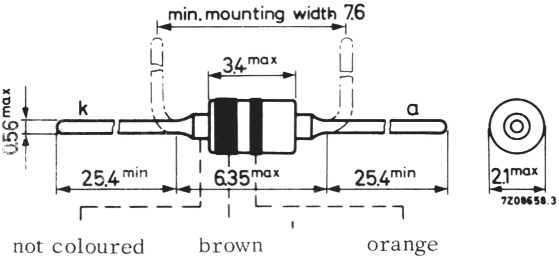

7Z09280
I_R (nA)
10^6
10^5
10^4
10^3
10^2
10
1
0
50
100
150
200
T_j (°C)
$V_R = 90V$
typ

SILICON OXIDE PASSIVATED DIODE

Whiskerless diode in a hardglass subminiature envelope.
The BAX13 is primarily intended for fast logic applications.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	50	V
Repetitive peak reverse voltage	V_{RRM}	max.	50	V
Repetitive peak forward current	I_{FRM}	max.	150	mA
Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	0.60	°C/mW
Forward voltage at I_F = 20 mA	V_F	<	1.0	V
Reverse recovery time when switched from I_F = 10 mA to V_R = 6 V; R_L = 100 Ω measured at I_R = 1 mA	t_{rr}	<	4	ns
Recovered charge when switched from I_F = 10 mA to V_R = 5 V R_L = 500 Ω	Q_s	<	45	pC

MECHANICAL DATA Dimensions in mm


min. mounting width 7.6
3.4 max
0.56 max
k
a
25.4 min
6.35 max
25.4 min
2.1 max
7Z08658.3
not coloured
brown
orange

RATINGS (Limiting values) 1)

Voltages				
Continuous reverse voltage	V_R	max.	50	V
Repetitive peak reverse voltage	V_{RRM}	max.	50	V
Currents				
Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	75	mA 2)
Forward current (d.c.)	I_F	max.	75	mA
Repetitive peak forward current	I_{FRM}	max.	150	mA
Non repetitive peak forward current $t = 1\ \mu s$	I_{FSM}	max.	2000	mA
$t = 1\ s$	I_{FSM}	max.	500	mA
Temperatures				
Storage temperature	T_{stg}		−65 to +200	°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.60	°C/mW

CHARACTERISTICS $T_j = 25\ ^\circ C$ unless otherwise specified

Forward voltage				
$I_F = 2$ mA	V_F	<	0.7	V
$I_F = 10$ mA; $T_j = 100\ ^\circ C$	V_F	<	0.8	V
$I_F = 20$ mA	V_F	<	1.0	V 3)
$I_F = 75$ mA	V_F	<	1.53	V 3)
Reverse current				
$V_R = 10$ V	I_R	<	25	nA
$V_R = 10$ V; $T_j = 150\ ^\circ C$	I_R	<	10	µA
$V_R = 25$ V	I_R	<	50	nA
$V_R = 50$ V	I_R	<	200	nA
$V_R = 50$ V; $T_j = 150\ ^\circ C$	I_R	<	25	µA
Diode capacitance (see also page 7)				
$V_R = 0$; f = 1 MHz	C_d	<	3	pF

---

1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

2) For sinusoidal operation see page 5.
For pulse operation see page 6.

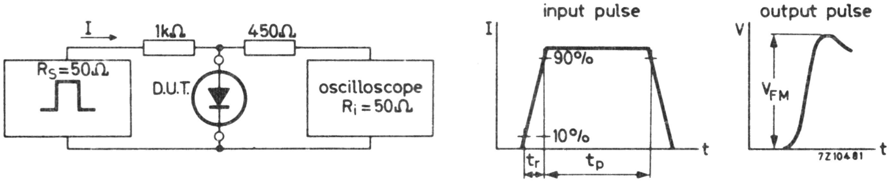
3) Measured under pulsed conditions to prevent excessive dissipation.

CHARACTERISTICS (continued) $T_j = 25\ ^{o}C$ unless otherwise specified

Forward recovery voltage (see also page 7)

At $t_r > 20$ ns, V_{FM} will not exceed V_F corresponding to $I_F = 1$ to 75 mA

Test circuit:


I
1kΩ
450Ω
R_S = 50Ω
D.U.T.
oscilloscope
R_i = 50Ω
input pulse
I
90%
10%
t
t_r
t_p
output pulse
V
V_FM
t
7Z10481

Current pulse: Rise time $t_r = 20$ ns

Pulse duration $t_p = 120$ ns

Duty cycle $\delta = 0.01$

Oscilloscope:

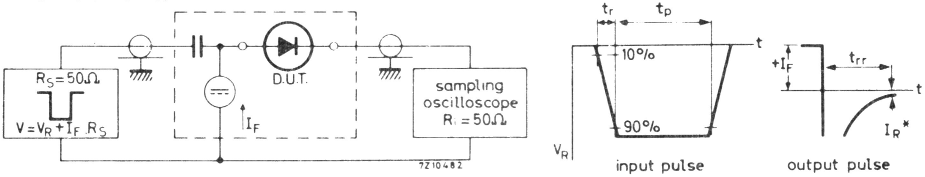
Rise time $t_r = 0.35$ ns

Circuit capacitance $C < 1$ pF (C = Oscilloscope + parasitical capacitance)

Reverse recovery time when switched from

$I_F = 10$ mA to V_R ; $R_L = 100\ \Omega$ (see also page 8)
measured at $I_R = 1$ mA; switched to $V_R = 1$ V $t_{rr} < 6$ ns
$V_R = 6$ V $t_{rr} < 4$ ns

Test circuit:


R_S = 50Ω
V = V_R + I_F . R_S
D.U.T.
I_F
sampling oscilloscope
R_i = 50Ω
7Z10482
t_r
t_p
t
10%
90%
V_R
input pulse
+I_F
t_rr
t
I_R*
output pulse

*) $I_R = 1$ mA

Reverse pulse: Rise time $t_r = 0.6$ ns

Pulse duration $t_p = 100$ ns

Duty cycle $\delta = 0.05$

Oscilloscope:

Rise time $t_r = 0.35$ ns

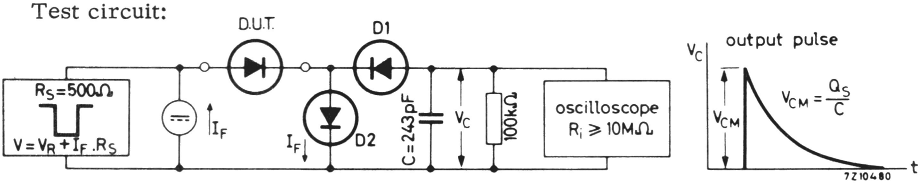
Circuit capacitance $C \leq 1$ pF (C = Oscilloscope + parasitical capacitance)

CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

Recovered charge when switched from

I_F = 10 mA to V_R = 5 V; R_L = 500 Ω Q_s < 45 pC

Test circuit:


D.U.T.
D1
$R_S = 500\Omega$
$V = V_R + I_F . R_S$
I_F
I_F
D2
C=243pF
V_C
100kΩ
oscilloscope
$R_i \geq 10M\Omega$
output pulse
V_C
V_{CM}
$V_{CM} = \frac{Q_S}{C}$
t
7Z10480

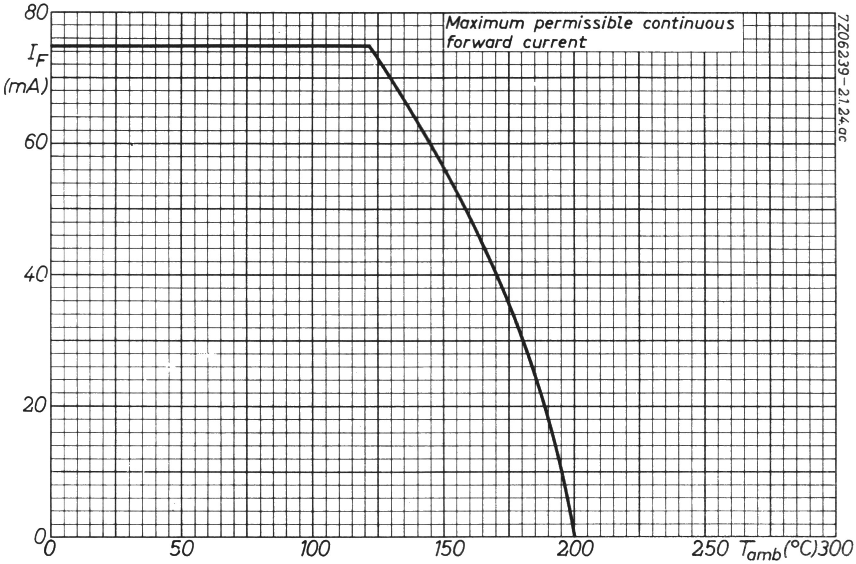
D1 = D2 = BAW62

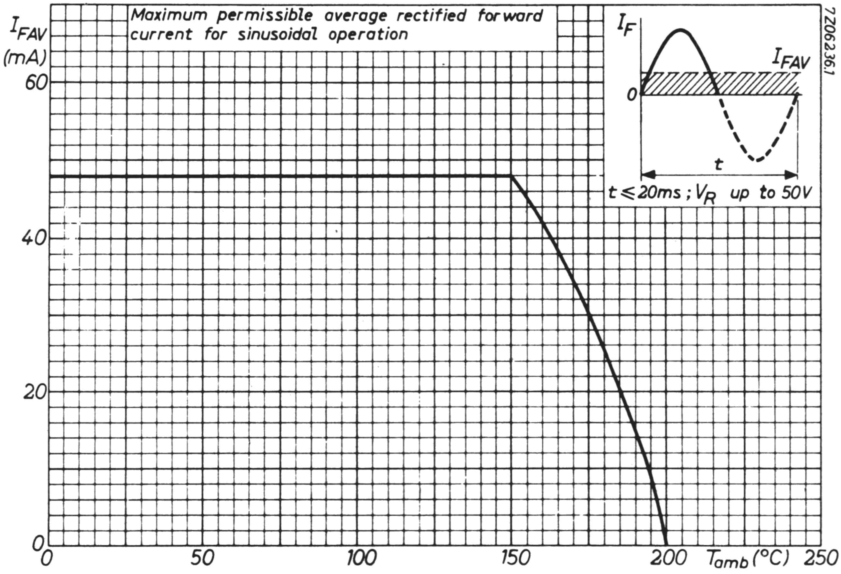
Reverse pulse: Rise time t_r = 2 ns

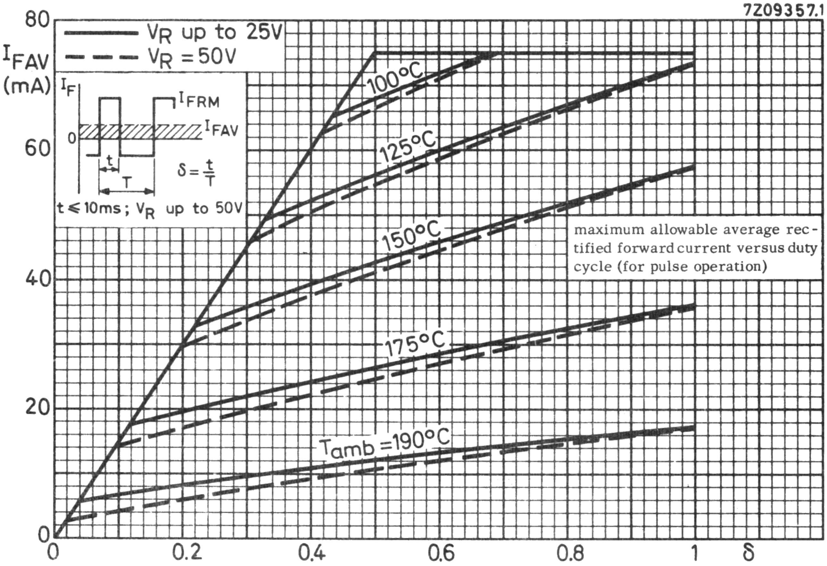
Pulse duration t_p = 400 ns

Duty cycle δ = 0.02

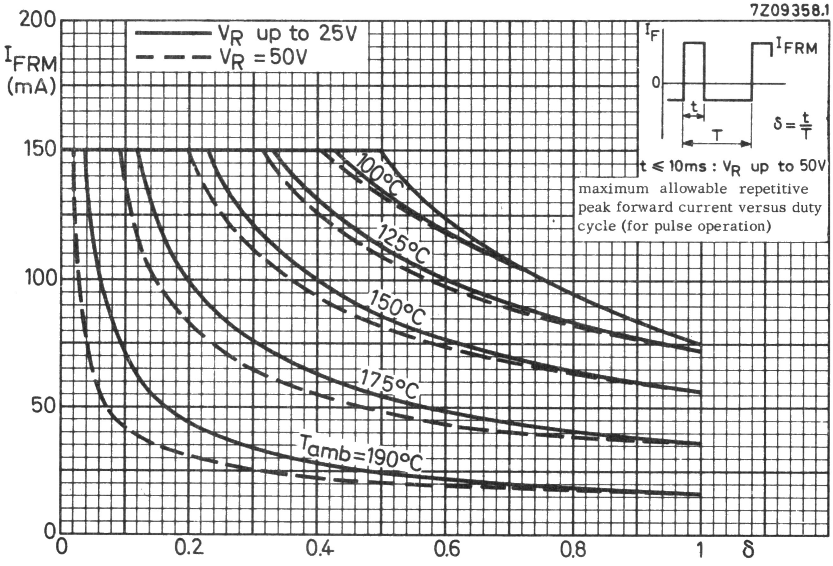
Circuit capacitance C < 7 pF (C = Oscilloscope + parasitical capacitance)


Maximum permissible continuous forward current
I_F (mA)
80
60
40
20
0
0
50
100
150
200
250
T_{amb} (°C)
300
7Z06239-2.1.24.ac

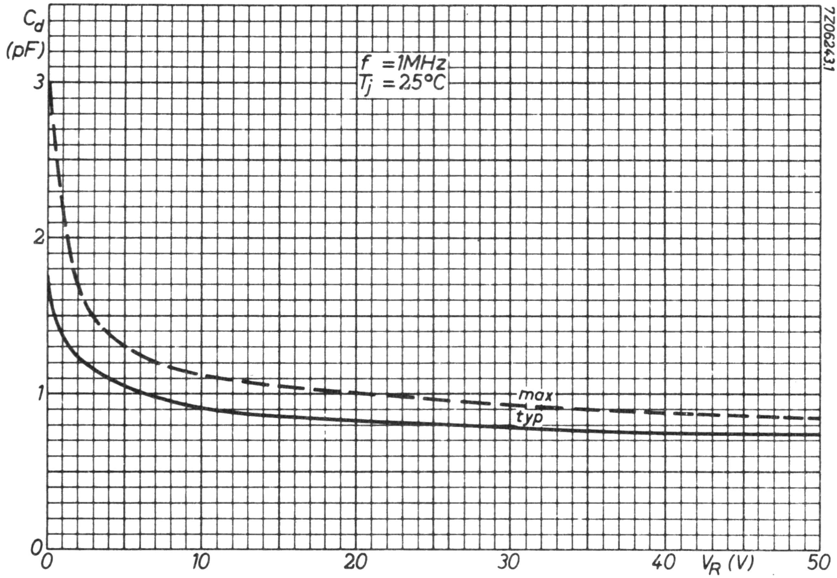

Maximum permissible average rectified forward current for sinusoidal operation
I_{FAV} (mA)
60
40
20
0
0
50
100
150
200
T_{amb} (°C)
250
I_F
I_{FAV}
0
t
$t \leq 20ms$; V_R up to 50V
7Z06236.1



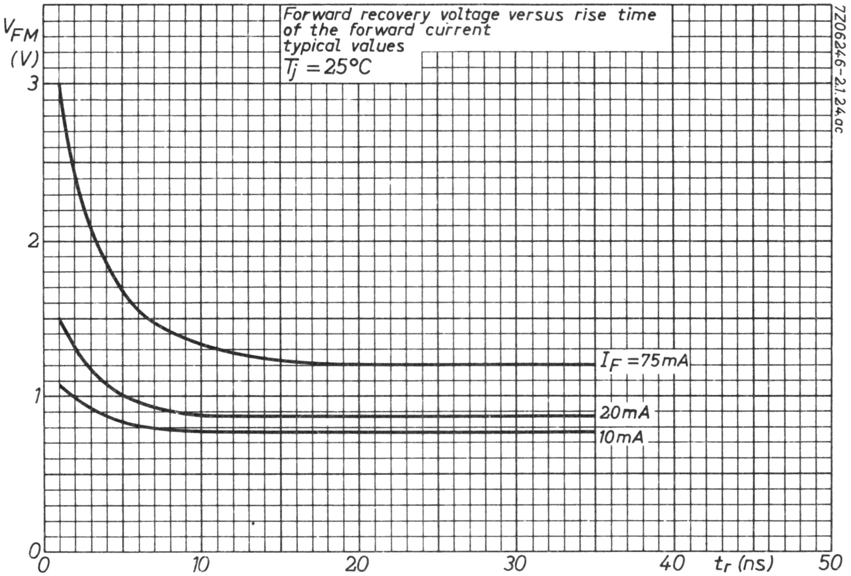
maximum allowable average rectified forward current versus duty cycle (for pulse operation)



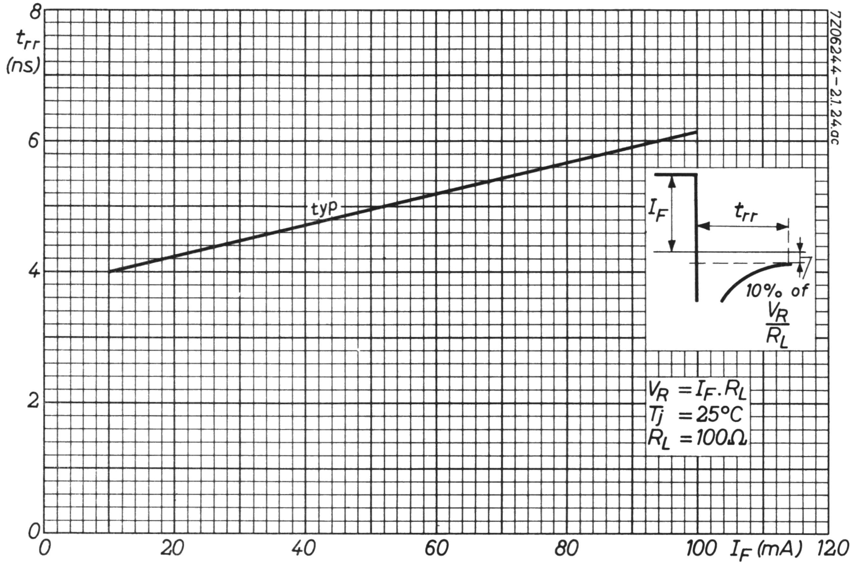
maximum allowable repetitive peak forward current versus duty cycle (for pulse operation)



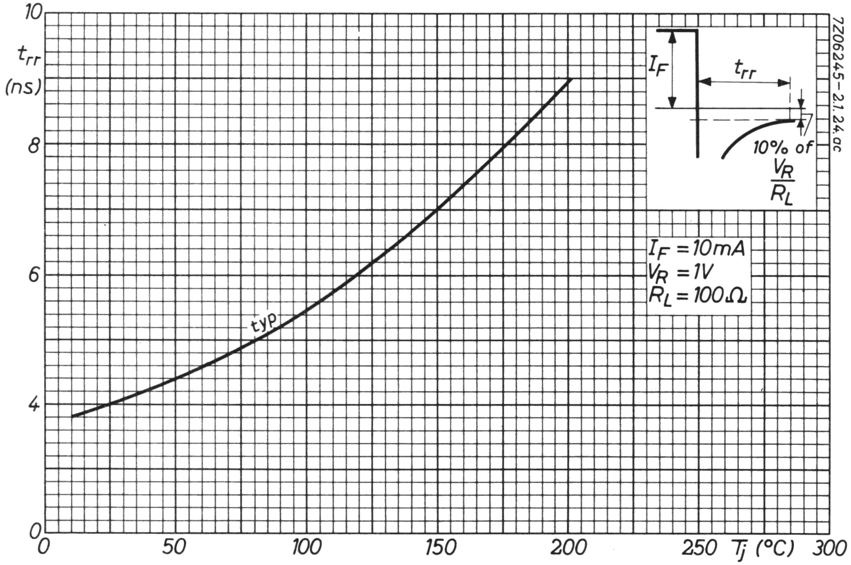
C_d
(pF)
3
2
1
0
f = 1MHz
T_j = 25°C
max
typ
0
10
20
30
40
V_R (V)
50
7Z06243.1



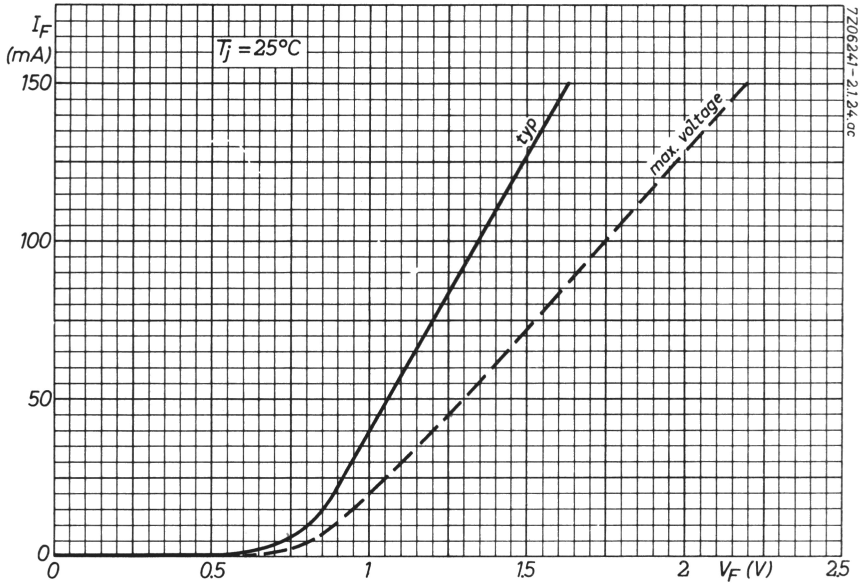
V_{FM}
(V)
3
2
1
0
Forward recovery voltage versus rise time
of the forward current
typical values
T_j = 25°C
I_F = 75mA
20mA
10mA
0
10
20
30
40
t_r (ns)
50
7Z06246-2.1.24.ac

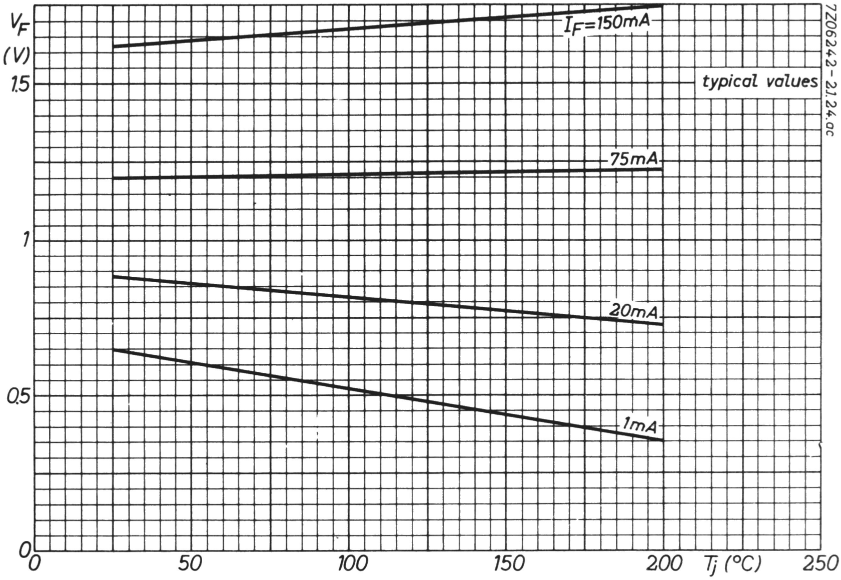


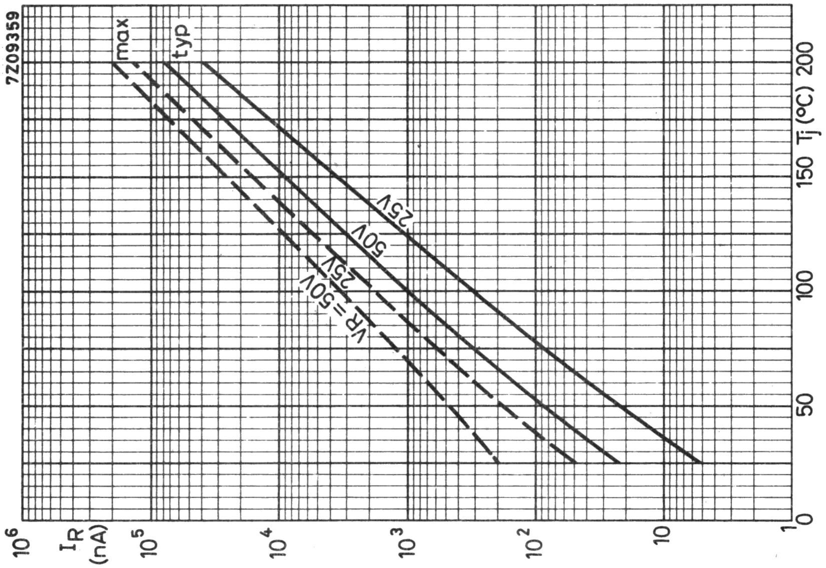
8
t_{rr}
(ns)
6
4
2
0
0
20
40
60
80
100
I_F (mA)
120
typ
I_F
t_{rr}
10% of
$\frac{V_R}{R_L}$
$V_R = I_F . R_L$
$T_j = 25°C$
$R_L = 100 \Omega$
7Z06244–2.1.24.ac

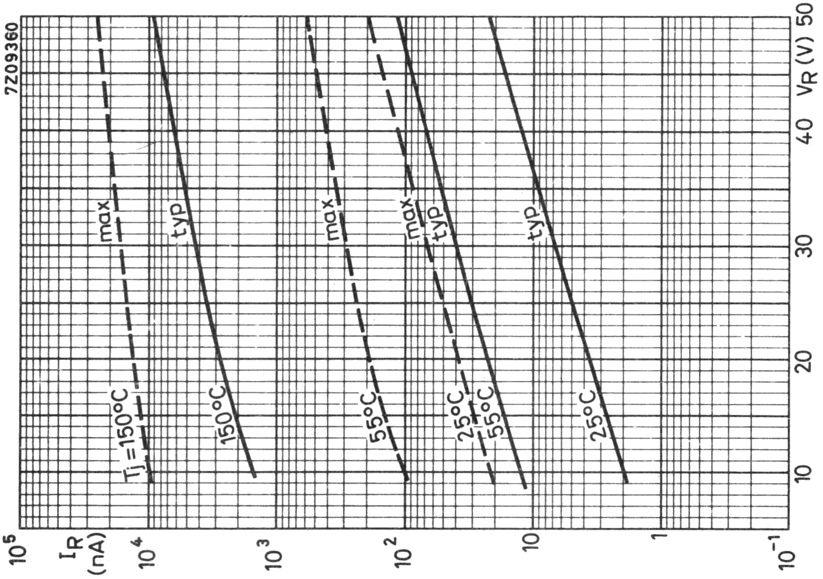


10
t_{rr}
(ns)
8
6
4
0
0
50
100
150
200
250
T_j (°C)
300
typ
I_F
t_{rr}
10% of
$\frac{V_R}{R_L}$
$I_F = 10 mA$
$V_R = 1V$
$R_L = 100 \Omega$
7Z06245–2.1.24.ac


I_F (mA)
T_j = 25°C
150
100
50
0
0
0.5
1
1.5
2
V_F (V)
2.5
typ
max. voltage
7Z06241-2.1.24.ac


V_F (V)
1.5
1
0.5
0
0
50
100
150
200
T_j (°C)
250
I_F=150mA
75mA
20mA
1mA
typical values
7Z06242-2.1.24.ac


7Z09359
I_R (nA)
10^6
10^5
10^4
10^3
10^2
10
1
0
50
100
150
200
T_j (°C)
max
typ
V_R = 50V
25V
50V
25V


7Z09360
I_R (nA)
10^5
10^4
10^3
10^2
10
1
10^{-1}
10
20
30
40
50
V_R (V)
T_j = 150°C
max
150°C
typ
55°C
max
25°C
max
55°C
typ
25°C
typ

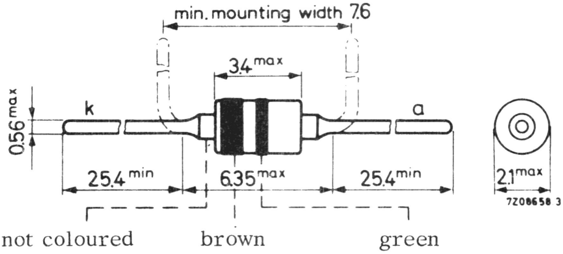
SILICON OXIDE PASSIVATED DIODE

Whiskerless diode in a subminiature envelope. The BAX15 is primarily intended for general purpose industrial applications.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	150	V
Repetitive peak reverse voltage	V_{RRM}	max.	180	V
Repetitive peak forward current	I_{FRM}	max.	500	mA
Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	0.4	°C/mW
Forward voltage at I_F = 100 mA	V_F	<	1.0	V
Reverse recovery time when switched from I_F = 30 mA to V_R = 3 V; R_L = 100 Ω measured at I_R = 1 mA	t_{rr}	<	300	ns
Recovered charge when switched from I_F = 10 mA to V_R = 5 V R_L = 500 Ω	Q_s	typ.	1	nC

MECHANICAL DATA

Dimensions in mm


min. mounting width 7.6
3.4 max
0.56 max
k
a
25.4 min
6.35 max
25.4 min
2.1 max
7Z08658 3
not coloured
brown
green

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages

Continuous reverse voltage	V_R	max.	150	V
Repetitive peak reverse voltage	V_{RRM}	max.	180	V

Currents

Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	250	mA [1]
Forward current (d.c.)	I_F	max.	250	mA
Repetitive peak forward current	I_{FRM}	max.	500	mA
Non repetitive peak forward current; $t \leq 10\ \mu s$	I_{FSM}	max.	30	A

Temperatures

Storage temperature	T_{stg}		-65 to +200	°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.4	°C/mW

CHARACTERISTICS $T_j = 25$ °C unless otherwise specified

Forward voltage

$I_F = 100$ mA	V_F	<	1.0	V
$I_F = 100$ mA; $T_j = 100$ °C	V_F	<	0.92	V
$I_F = 250$ mA	V_F	<	1.35	V

Reverse current

$V_R = 150$ V	I_R	<	200	nA
$V_R = 150$ V; $T_j = 100$ °C	I_R	<	10	μA

Diode capacitance (see also page 7)

$V_R = 0$; f = 1 MHz	C_d	<	20	pF

---

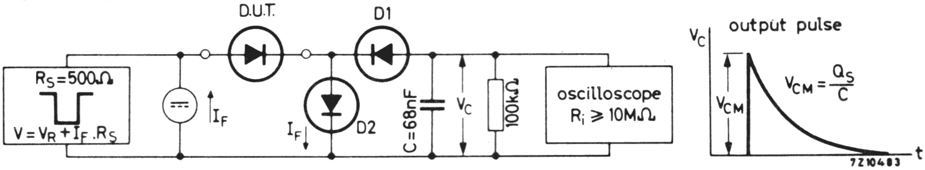
[1] For sinusoidal operation see page 5.
For pulse operation see page 6.

CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

Recovered charge when switched from

I_F = 10 mA to V_R = 5 V; R_L = 500 Ω Q_s typ. 1 nC

Test circuit:


D.U.T.
D1
$R_S = 500\Omega$
$V = V_R + I_F . R_S$
I_F
I_F
D2
C=68nF
V_C
100kΩ
oscilloscope
$R_i \geqslant 10M\Omega$
V_C
output pulse
$V_{CM} = \frac{Q_S}{C}$
V_{CM}
t
7Z10483

D1 = D2 = BAW62

Reverse pulse: Rise time t_r = 15 ns

Pulse duration t_p = 35 μs

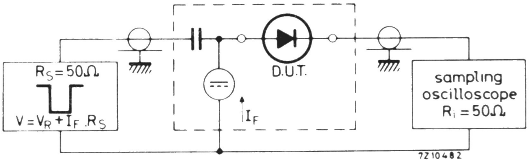
Frequency f = 25 kHz

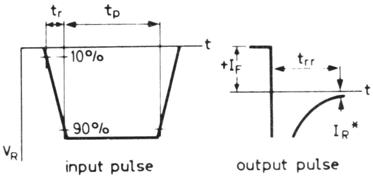
Circuit capacitance C < 30 pF (C = Oscilloscope + parasitical capacitance)

Reverse recovery time when switched from

I_F = 30 mA to V_R = 3 V; R_L = 100 Ω
measured at I_R = 3 mA t_{rr} < 300 ns

Test circuit:


$R_S = 50\Omega$
$V = V_R + I_F . R_S$
D.U.T.
I_F
sampling
oscilloscope
$R_i = 50\Omega$
7Z10482


t_r
t_p
t
10%
90%
V_R
input pulse
$+I_F$
t_{rr}
t
I_R*
output pulse

*) I_R = 3 mA

Reverse pulse: Rise time t_r = 0.6 ns

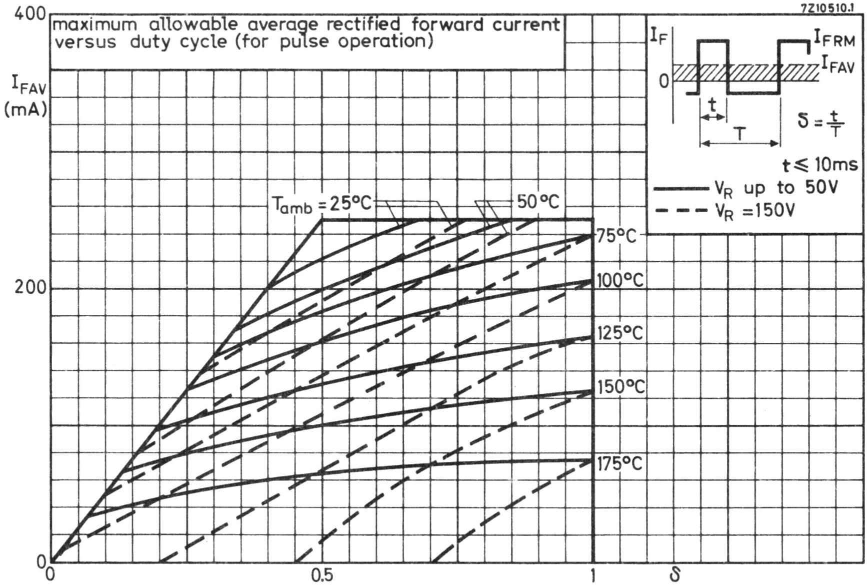
Pulse duration t_p = 100 ns

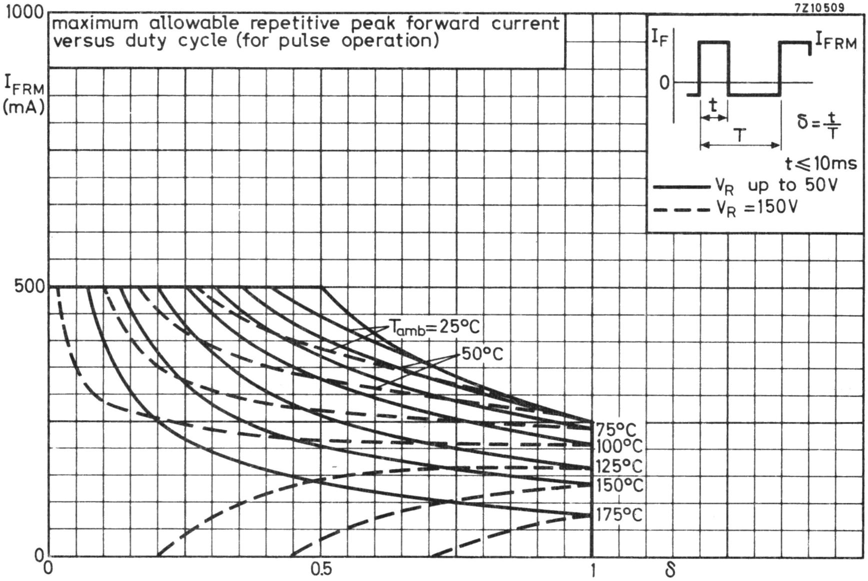
Duty cycle δ = 0.05

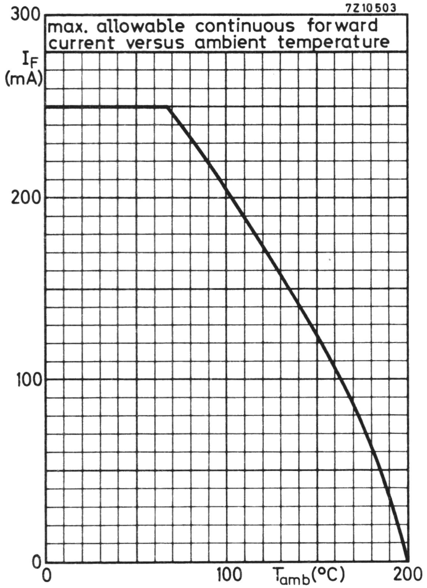
Oscilloscope:

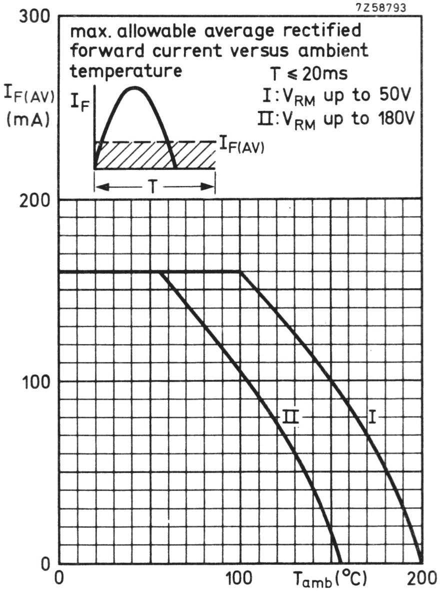
Rise time t_r = 0.35 ns

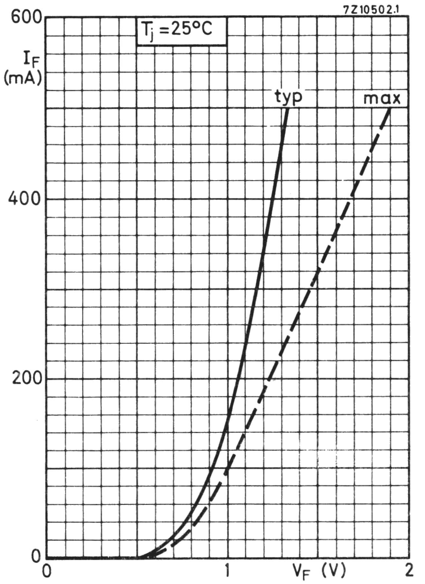
Circuit capacitance C ≤ 1 pF (C = Oscilloscope + parasitical capacitance)

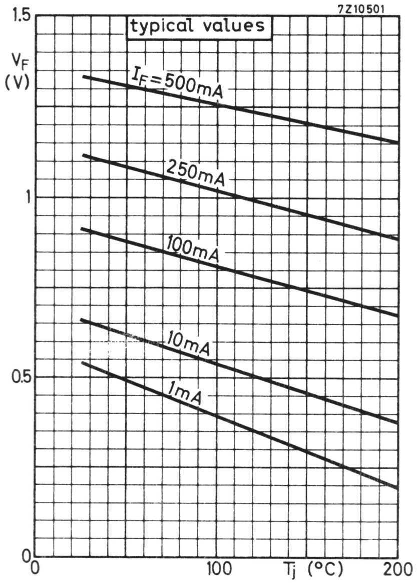

7Z10510.1
maximum allowable average rectified forward current versus duty cycle (for pulse operation)
400
200
0
I_{FAV} (mA)
0
0.5
1
δ
T_{amb} = 25°C
50°C
75°C
100°C
125°C
150°C
175°C
I_F
I_{FRM}
I_{FAV}
0
t
T
δ = t/T
t ≤ 10ms
V_R up to 50V
V_R =150V

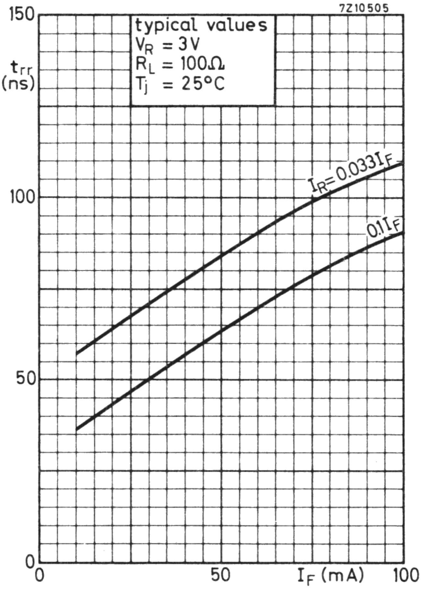

7Z10509
maximum allowable repetitive peak forward current versus duty cycle (for pulse operation)
1000
500
0
I_{FRM} (mA)
0
0.5
1
δ
T_{amb}=25°C
50°C
75°C
100°C
125°C
150°C
175°C
I_F
I_{FRM}
0
t
T
δ = t/T
t ≤ 10ms
V_R up to 50V
V_R =150V

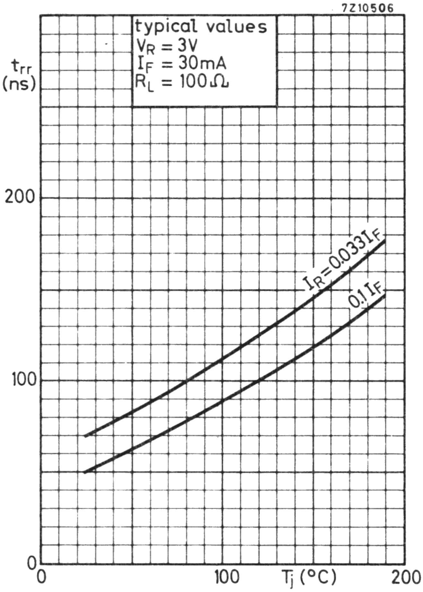

7Z10503
max. allowable continuous forward current versus ambient temperature
300
I_F (mA)
200
100
0
0
100
T_{amb}(°C)
200

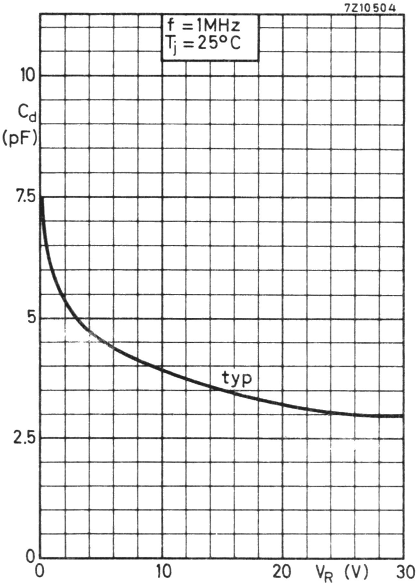

7Z58793
max. allowable average rectified forward current versus ambient temperature
T ≤ 20ms
I: V_{RM} up to 50V
II: V_{RM} up to 180V
I_F
$I_{F(AV)}$
T
300
$I_{F(AV)}$ (mA)
200
100
0
II
I
0
100
T_{amb}(°C)
200

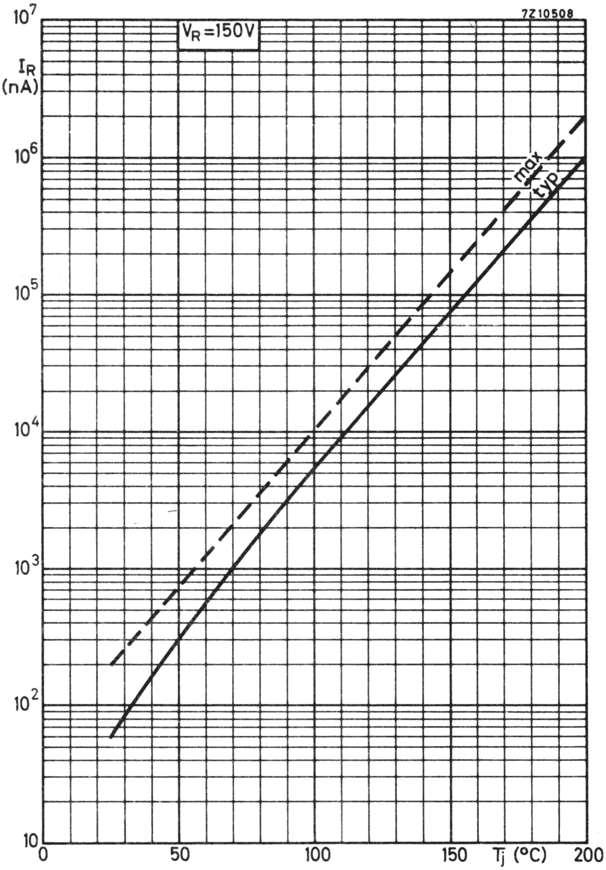

7Z10502.1
T_j = 25°C
600
I_F (mA)
typ
max
400
200
0
0
1
V_F (V)
2


7Z10501
typical values
1.5
V_F (V)
I_F = 500mA
250mA
1
100mA
10mA
0.5
1mA
0
0
100
T_j (°C)
200


7Z10505
typical values
V_R = 3V
R_L = 100Ω
T_j = 25°C
t_{rr}
(ns)
150
100
50
0
I_R= 0.033I_F
0.1I_F
0
50
I_F (mA)
100


7Z10506
typical values
V_R = 3V
I_F = 30mA
R_L = 100Ω
t_{rr}
(ns)
200
100
0
I_R=0.033I_F
0.1I_F
0
100
T_j (°C)
200


7Z10504
f = 1MHz
T_j = 25°C
10
C_d
(pF)
7.5
5
2.5
0
typ
0
10
20
V_R (V)
30


7Z10508
$V_R = 150V$
I_R (nA)
10^7
10^6
10^5
10^4
10^3
10^2
10
0
50
100
150
T_j (°C)
200
max
typ

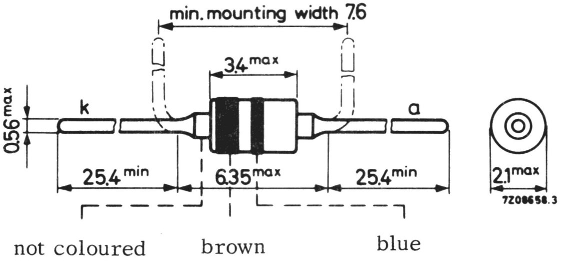
SILICON OXIDE PASSIVATED DIODE

Whiskerless diffused diode in a molybdenum hard glass subminature envelope. The BAX16 is primarily intended for general purpose industrial applications.

QUICK REFERENCE DATA

Continuous reverse voltage	V_R	max.	150	V
Repetitive peak forward current	I_{FRM}	max.	300	mA
Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	0.40	°C/mW
Forward voltage at I_F = 100 mA	V_F	<	1.3	V
Reverse recovery time when switched from I_F = 30 mA to V_R = 3 V; R_L = 100 Ω measured at I_R = 1 mA	t_{rr}	<	120	ns
Recovered charge when switched from I_F = 10 mA to V_R = 5 V R_L = 500 Ω	Q_s	<	0.7	nC

MECHANICAL DATA Dimensions in mm


min. mounting width 7.6
3.4max
0.56max
k
a
25.4min
6.35max
25.4min
2.1max
7Z08658.3
not coloured
brown
blue

RATINGS (Limiting values) [1]

Voltages

Continuous reverse voltage	V_R	max.	150	V [2]
Repetitive peak reverse voltage	V_{RRM}	max.	150	V

Currents

Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	200	mA [3]
Forward current (d.c.)	I_F	max.	200	mA
Repetitive peak forward current	I_{FRM}	max.	300	mA
Non repetitive peak forward current $t = 1\ \mu s$	I_{FSM}	max.	2500	mA
$t = 1$ s	I_{FSM}	max.	500	mA

Temperatures

Storage temperature	T_{stg}		-65 to +200	°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.40	°C/mW

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified

Forward voltage

$I_F = 1$ mA	V_F	<	0.65	V
$I_F = 10$ mA; $T_j = 100$ °C	V_F	<	0.85	V
$I_F = 100$ mA	V_F	<	1.3	V [4]
$I_F = 200$ mA	V_F	<	1.5	V [4]
$I_F = 200$ mA; $T_j = 175$ °C	V_F	<	1.4	V [4]

Reverse current

$V_R = 50$ V	I_R	<	25	nA
$V_R = 50$ V; $T_j = 150$ °C	I_R	<	25	µA
$V_R = 150$ V	I_R	<	100	nA
$V_R = 150$ V; $T_j = 150$ °C	I_R	<	100	µA

Diode capacitance (see also page 5)

$V_R = 0$; $f = 1$ MHz	C_d	<	10	pF

---

[1] Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

[2] Measured at zero lifetime at $I_R = 10\ \mu A$: $V_R > 165$ V.

[3] For sinusoidal operation see page 5. For pulse operation see page 4.

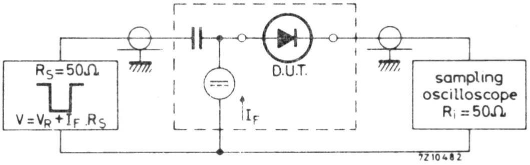
[4] Measured under pulsed conditions to prevent excessive dissipation.

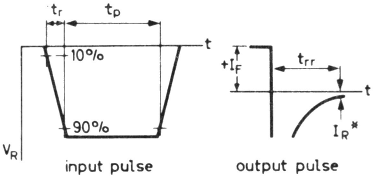
CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

Reverse recovery time when switched from

I_F = 30 mA to V_R = 3 V; R_L = 100 Ω
(see also page 6) measured at I_R = 1 mA t_{rr} typ. 70 ns
< 120 ns

Test circuit:


$R_S = 50\Omega$
$V = V_R + I_F . R_S$
D.U.T.
I_F
sampling
oscilloscope
$R_i = 50\Omega$
7Z10482


t_r
t_p
t
10%
90%
V_R
input pulse
$+I_F$
t_{rr}
t
I_R*
output pulse

*) I_R = 1 mA

Reverse pulse: Rise time t_r = 0.6 ns
Pulse duration t_p = 100 ns
Duty cycle δ = 0.05

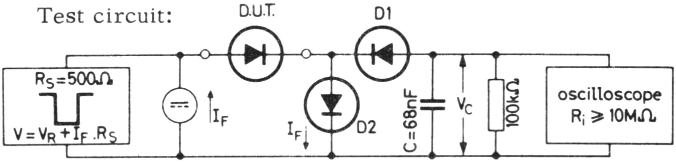
Oscilloscope:
Rise time t_r = 0.35 ns

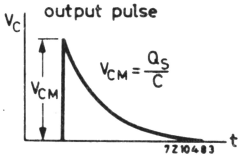
Circuit capacitance C ≤ 1 pF (C = Oscilloscope + parasitical capacitance)

Recovered charge when switched from

I_F = 10 mA to V_R = 5 V; R_L = 500 Ω Q_S < 0.7 nC

Test circuit:

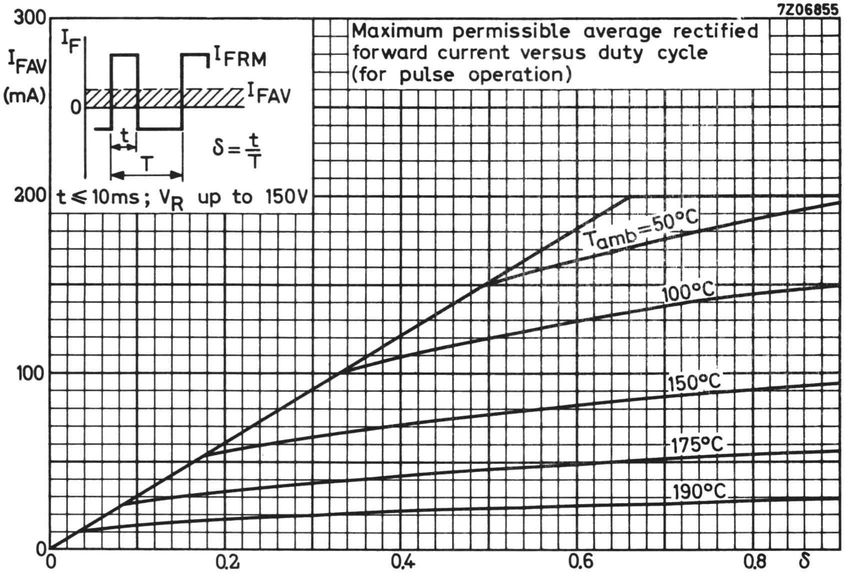

D.U.T.
D1
$R_S = 500\Omega$
$V = V_R + I_F . R_S$
I_F
I_F
D2
C=68nF
V_C
100kΩ
oscilloscope
$R_i \geqslant 10M\Omega$

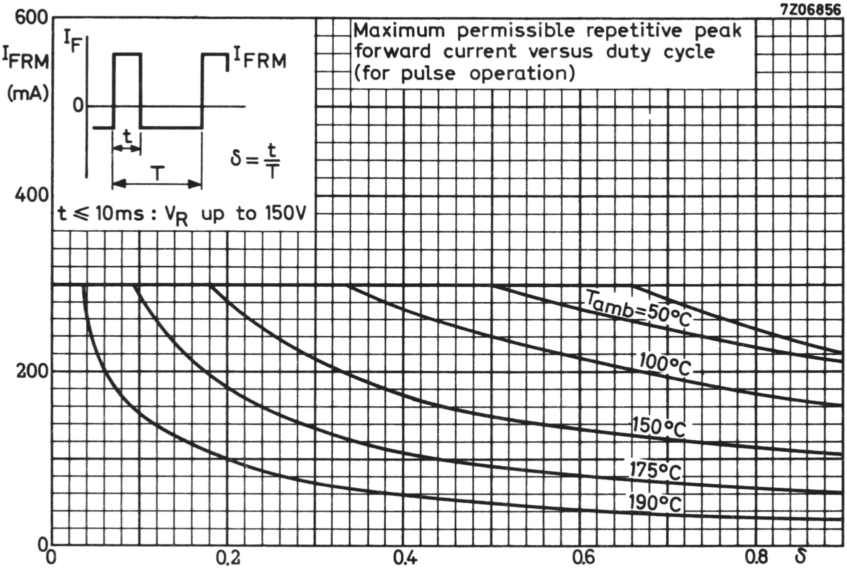

V_C
output pulse
V_{CM}
$V_{CM} = \frac{Q_S}{C}$
t
7Z10483

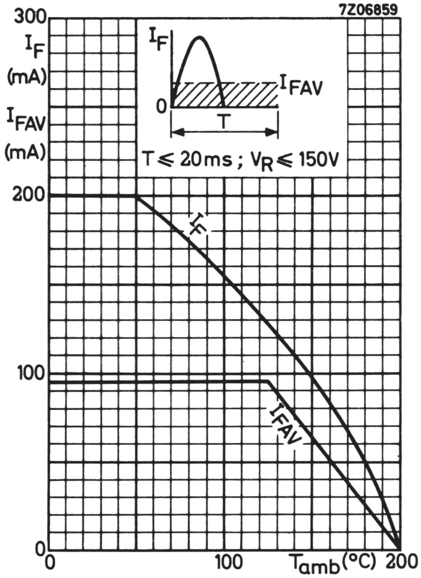
D1 = D2 = BAW62

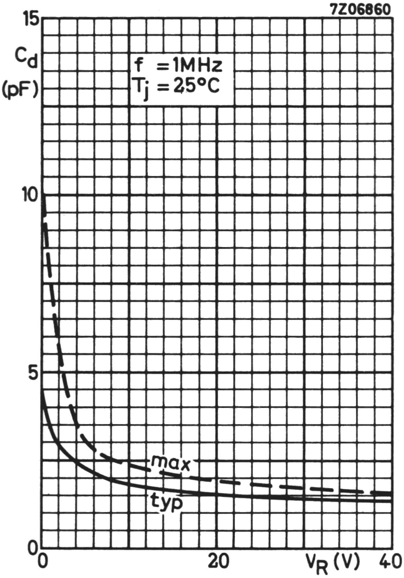
Reverse pulse: Rise time t_r = 15 ns
Pulse duration t_p = 35 μs
Frequency f = 25 kHz

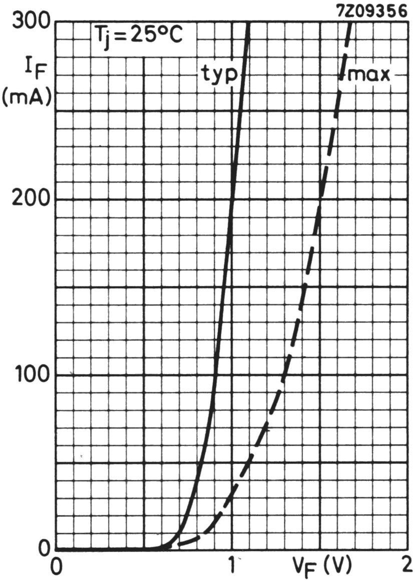
Circuit capacitance C < 30 pF (C = Oscilloscope + parasitical capacitance)

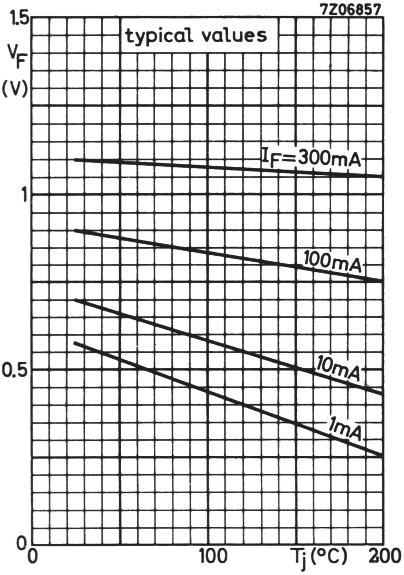

7Z06855
Maximum permissible average rectified forward current versus duty cycle (for pulse operation)
I_{FAV} (mA)
300
200
100
0
I_F
I_{FRM}
I_{FAV}
0
t
T
$\delta = \frac{t}{T}$
$t \leqslant 10$ms; V_R up to 150V
T_{amb}=50°C
100°C
150°C
175°C
190°C
0
0.2
0.4
0.6
0.8
δ

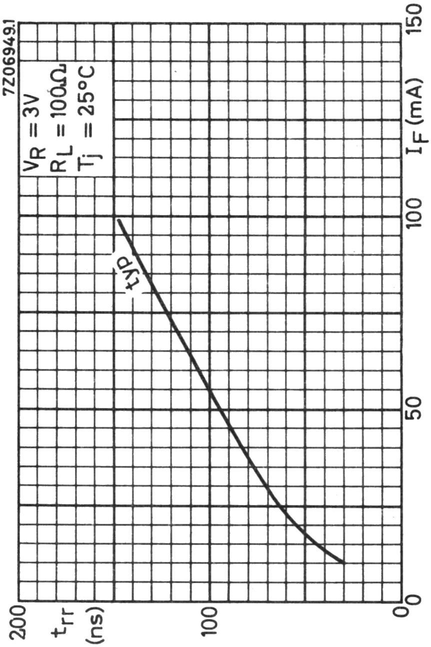

7Z06856
Maximum permissible repetitive peak forward current versus duty cycle (for pulse operation)
I_{FRM} (mA)
600
400
200
0
I_F
I_{FRM}
0
t
T
$\delta = \frac{t}{T}$
$t \leqslant 10$ms : V_R up to 150V
T_{amb}=50°C
100°C
150°C
175°C
190°C
0
0.2
0.4
0.6
0.8
δ

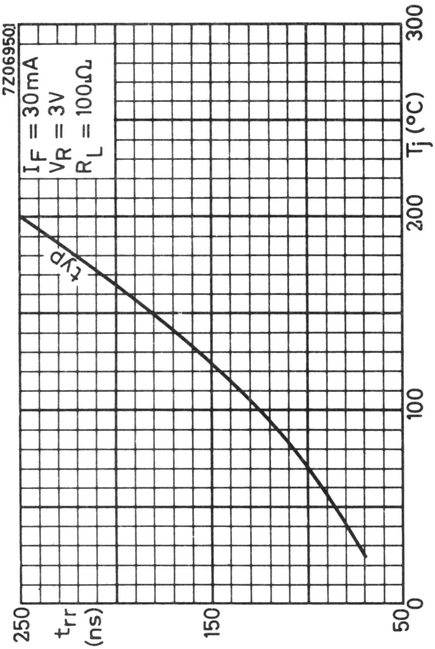

7Z06859
I_F (mA)
I_{FAV} (mA)
300
200
100
0
I_F
I_{FAV}
0
T
T ≤ 20 ms ; V_R ≤ 150 V
I_F
I_{FAV}
0
100
T_{amb} (°C)
200

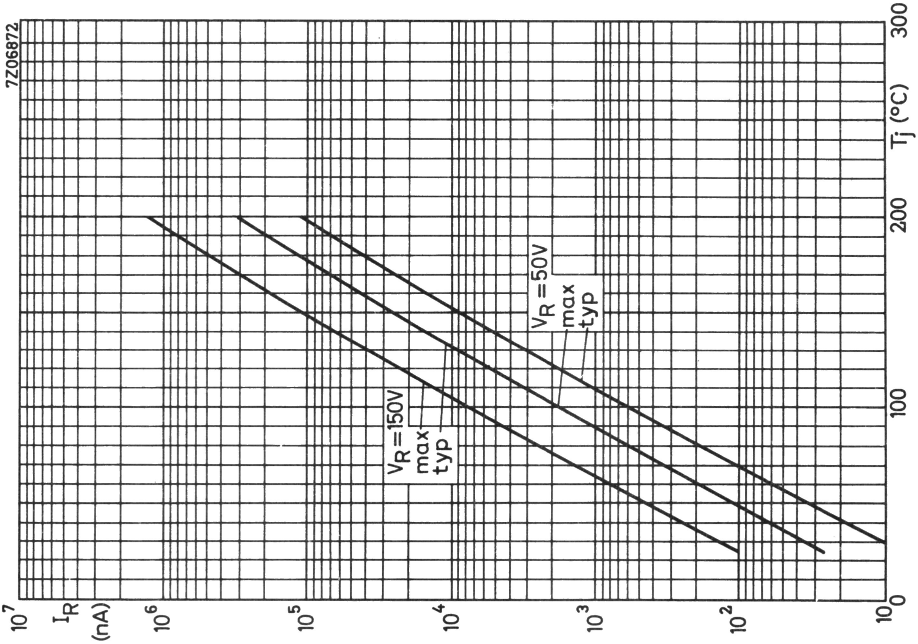

7Z06860
C_d (pF)
15
10
5
0
f = 1 MHz
T_j = 25 °C
max
typ
0
20
V_R (V)
40


7Z09356
I_F (mA)
300
200
100
0
T_j = 25 °C
typ
max
0
1
V_F (V)
2


7Z06857
V_F (V)
1.5
1
0.5
0
typical values
I_F = 300 mA
100 mA
10 mA
1 mA
0
100
T_j (°C)
200


7Z06949.1
V_R = 3V
R_L = 100Ω
T_j = 25°C
typ
t_{rr} (ns)
200
100
0
I_F (mA)
0
50
100
150


7Z06950.1
I_F = 30mA
V_R = 3V
R_L = 100Ω
typ
t_{rr} (ns)
250
150
50
T_j (°C)
0
100
200
300


7Z06872
I_R (nA)
10^7
10^6
10^5
10^4
10^3
10^2
10
V_R=150V
max
typ
V_R =50V
max
typ
T_j (°C)
0
100
200
300

SILICON OXIDE PASSIVATED DIODE

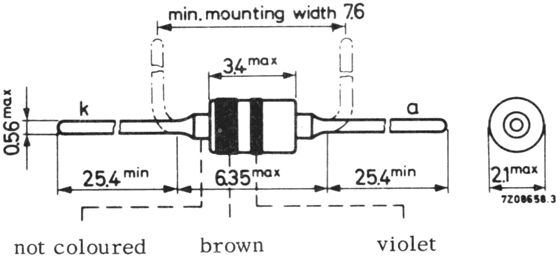
Whiskerless diffused diode in a molybdenum hard glass subminiature envelope. The BAX17 is primarily intended for general purpose industrial applications.

QUICK REFERENCE DATA

Continuous reverse voltage	V_R	max.	200	V
Repetitive peak forward current	I_{FRM}	max.	300	mA
Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	0.40	°C/mW
Forward voltage at I_F = 200 mA	V_F	<	1.2	V
Reverse recovery time when switched from I_F = 30 mA to V_R = 3 V; R_L = 100 Ω measured at I_R = 1 mA	t_{rr}	<	120	ns
Recovered charge when switched from I_F = 10 mA to V_R = 5 V R_L = 500 Ω	Q_s	<	0.7	nC

MECHANICAL DATA

Dimensions in mm


min. mounting width 7.6
3.4 max
0.56 max
k
a
25.4 min
6.35 max
25.4 min
2.1 max
7Z08658.3
not coloured
brown
violet

RATINGS (Limiting values) 1)

Voltages

Continuous reverse voltage	V_R	max.	200	V 2)
Repetitive peak reverse voltage	V_{RRM}	max.	200	V

Currents

Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	200	mA 3)
Forward current (d.c.)	I_F	max.	200	mA
Repetitive peak forward current	I_{FRM}	max.	300	mA
Non repetitive peak forward current				
$t = 1\ \mu s$	I_{FSM}	max.	2500	mA
$t = 1$ s	I_{FSM}	max.	500	mA

Temperatures

Storage temperature	T_{stg}		−65 to +200	°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.40	°C/mW

CHARACTERISTICS

$T_j = 25\ ^oC$ unless otherwise specified

Forward voltage

$I_F = 1$ mA	V_F	<	0.65	V
$I_F = 10$ mA; $T_j = 100\ ^oC$	V_F	<	0.75	V
$I_F = 100$ mA	V_F	<	1.1	V 4)
$I_F = 200$ mA	V_F	<	1.2	V 4)
$I_F = 200$ mA; $T_j = 175\ ^oC$	V_F	<	1.2	V 4)

Reverse current

$V_R = 50$ V	I_R	<	25	nA
$V_R = 50$ V; $T_j = 150\ ^oC$	I_R	<	25	μA
$V_R = 150$ V	I_R	<	100	nA
$V_R = 200$ V; $T_j = 150\ ^oC$	I_R	<	100	μA

Diode capacitance (see also page 5)

$V_R = 0$; f = 1 MHz	C_d	<	10	pF

---

1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

2) Measured at zero lifetime at $I_R = 10\ \mu A$: $V_R \geq 220$ V.

3) For sinusoidal operation see page 5. For pulse operation see page 4.

4) Measured under pulsed conditions to prevent excessive dissipation.

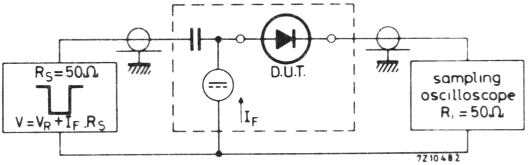
CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

Reverse recovery time when switched from

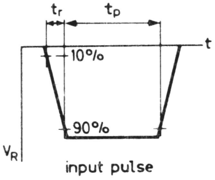
I_F = 30 mA to V_R = 3 V; R_L = 100 Ω
(see also page 6) measured at I_R = 1 mA

t_{rr}	typ.	70	ns
	<	120	ns

Test circuit:

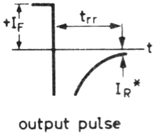


$R_S = 50\Omega$
$V = V_R + I_F.R_S$
D.U.T.
I_F
sampling oscilloscope $R_i = 50\Omega$
7Z10482



t_r
t_p
t
10%
90%
V_R

input pulse



output pulse

*) I_R = 1 mA

Reverse pulse: Rise time t_r = 0.6 ns
Pulse duration t_p = 100 ns
Duty cycle δ = 0.05

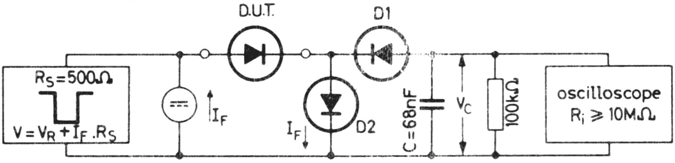
Oscilloscope:
Rise time t_r = 0.35 ns

Circuit capacitance $C \leq 1$ pF (C = Oscilloscope + parasitical capacitance)

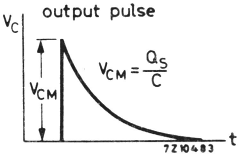
Recovered charge when switched from

I_F = 10 mA to V_R = 5 V; R_L = 500 Ω Q_s < 0.7 nC

Test circuit:



$R_S = 500\Omega$
$V = V_R + I_F.R_S$
D.U.T.
D1
I_F
I_F
D2
C = 68nF
V_C
100kΩ
oscilloscope $R_i \geq 10M\Omega$

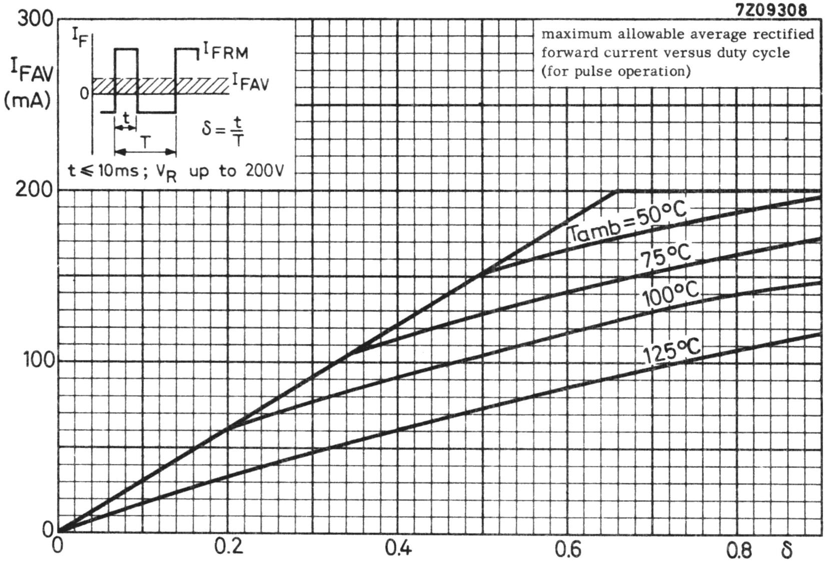


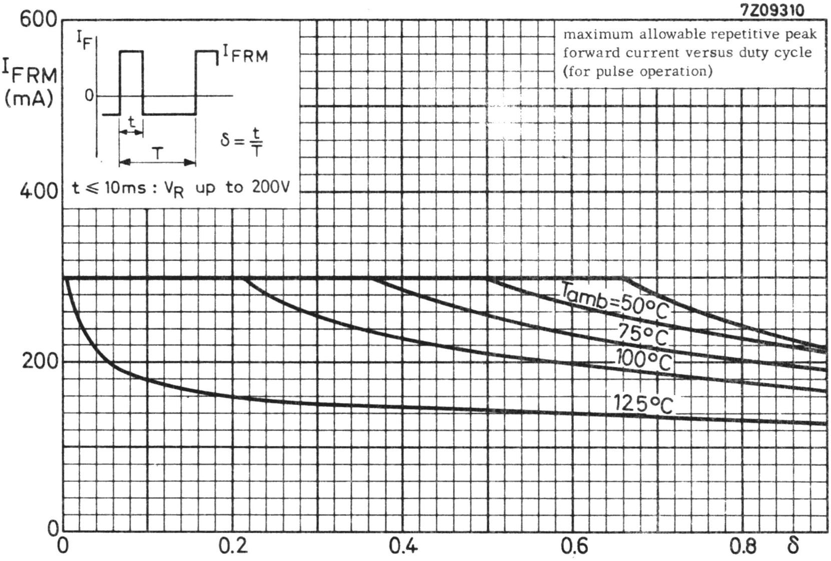
V_C
output pulse
V_{CM}
$V_{CM} = \frac{Q_S}{C}$
t
7Z10483

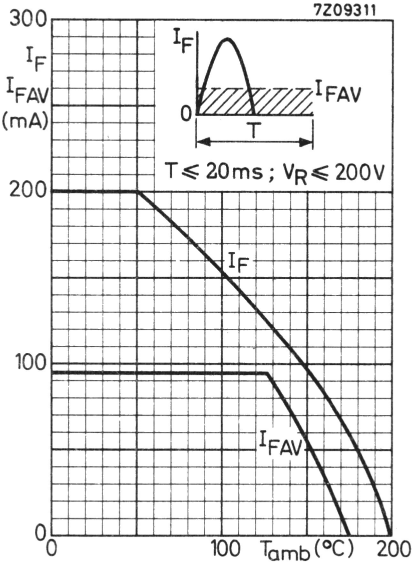
D1 = D2 = BAW62

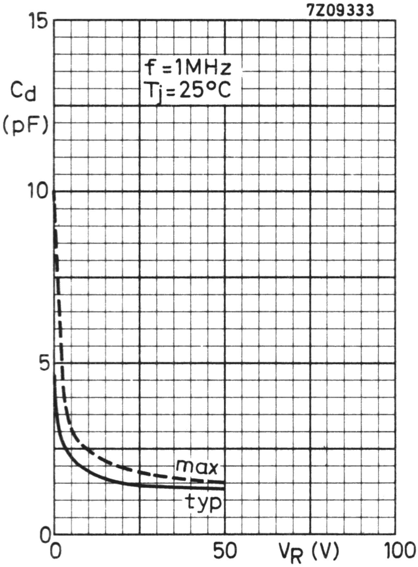
Reverse pulse: Rise time t_r = 15 ns
Pulse duration t_p = 35 μs
Frequency f = 25 kHz

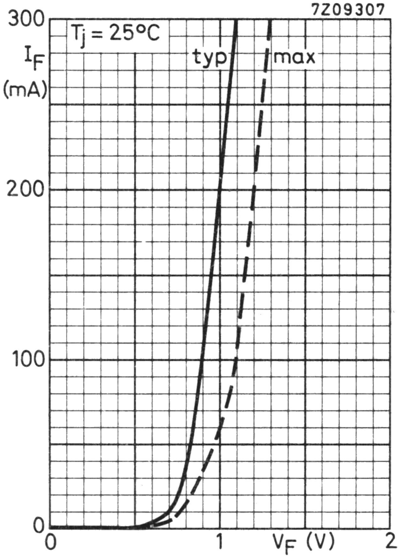
Circuit capacitance C < 30 pF (C = Oscilloscope + parasitical capacitance)

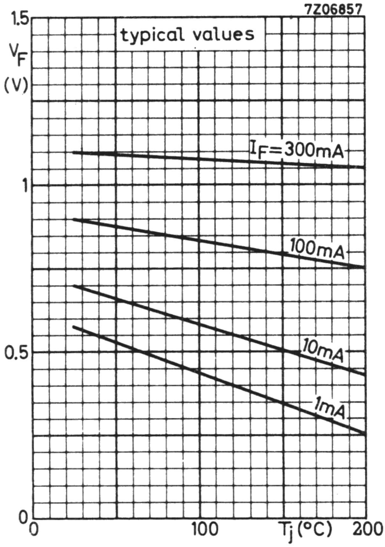

7Z09308
maximum allowable average rectified forward current versus duty cycle (for pulse operation)
300
200
100
0
I_{FAV} (mA)
I_F
I_{FRM}
I_{FAV}
0
t
T
$\delta = \frac{t}{T}$
t ⩽ 10ms; V_R up to 200V
Tamb=50°C
75°C
100°C
125°C
0
0.2
0.4
0.6
0.8
δ

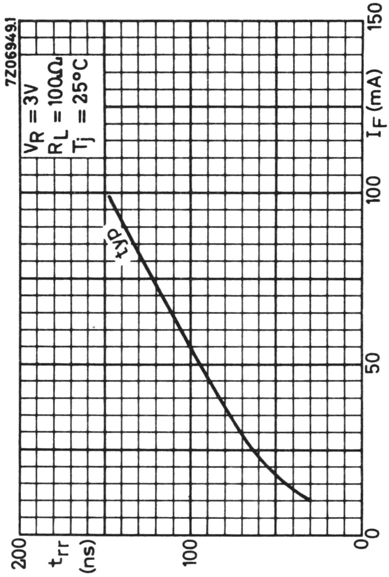

7Z09310
maximum allowable repetitive peak forward current versus duty cycle (for pulse operation)
600
400
200
0
I_{FRM} (mA)
I_F
I_{FRM}
0
t
T
$\delta = \frac{t}{T}$
t ⩽ 10ms : V_R up to 200V
Tamb=50°C
75°C
100°C
125°C
0
0.2
0.4
0.6
0.8
δ

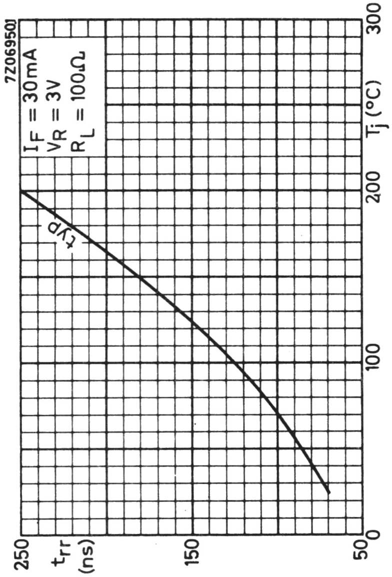

7Z09311
300
I_F
I_{FAV}
(mA)
200
100
0
0
100
T_{amb} (°C)
200
I_F
I_{FAV}
0
T
I_F
I_{FAV}
T ⩽ 20ms ; V_R ⩽ 200V

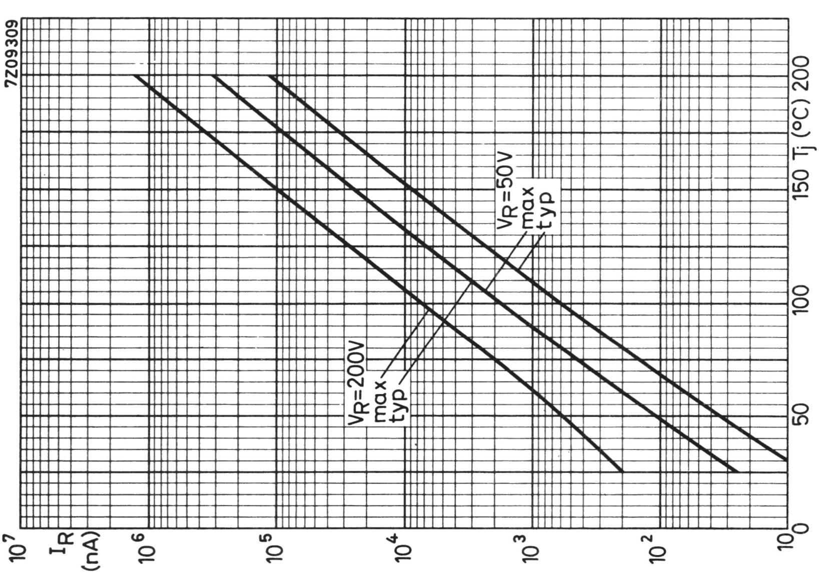

7Z09333
15
C_d
(pF)
10
5
0
0
50
V_R (V)
100
f = 1MHz
T_j = 25°C
max
typ


7Z09307
300
I_F
(mA)
200
100
0
0
1
V_F (V)
2
T_j = 25°C
typ
max


7Z06857
1.5
V_F
(V)
1
0.5
0
0
100
T_j (°C)
200
typical values
I_F=300mA
100mA
10mA
1mA


7Z06949.1
$V_R = 3V$
$R_L = 100\Omega$
$T_j = 25°C$
t_{rr} (ns)
200
100
0
typ
0
50
100
150
I_F (mA)


7Z06950.1
$I_F = 30mA$
$V_R = 3V$
$R_L = 100\Omega$
t_{rr} (ns)
250
150
50
typ
0
100
200
300
T_j (°C)


7Z09309
10^7
I_R (nA)
10^6
10^5
10^4
10^3
10^2
10
V_R=200V
max
typ
V_R=50V
max
typ
0
50
100
150
200
T_j (°C)

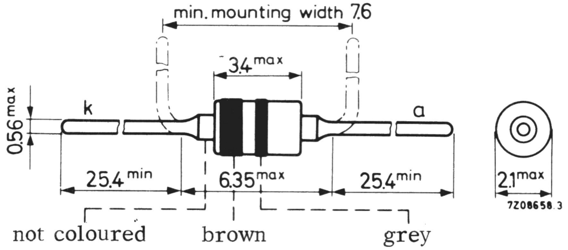
SILICON OXIDE PASSIVATED DIODE

Whiskerless diffused diode in a molybdenum hard glass subminiature envelope.
The BAX18 is a general purpose diode primarily intended for rectifier applications.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	75	V
Repetitive peak reverse voltage	V_{RRM}	max.	75	V
Average forward current	I_{FAV}	max.	350	mA
Junction temperature	T_j	max.	200	°C
Thermal resistance from junction to ambient	$R_{th\ j-a}$	=	0.3	°C/mW

MECHANICAL DATA

Dimensions in mm


min. mounting width 7.6
3.4 max
0.56 max
k
a
25.4 min
6.35 max
25.4 min
2.1 max
7Z08658.3
not coloured
brown
grey

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages				
Continuous reverse voltage	V_R	max.	75	V
Repetitive peak reverse voltage	V_{RRM}	max.	75	V
Currents				
Average rectified forward current (see page 5)	I_{FAV}	max.	350	mA
Forward current (d.c.)	I_F	max.	500	mA
Repetitive peak forward current	I_{FRM}	max.	2.0	A
Non repetitive peak forward current t = 10 ms; half sine wave	I_{FSM}	max.	6.0	A
Temperatures				
Storage temperature	T_{stg}		-65 to +200	^oC
Junction temperature	T_j	max.	200	^oC

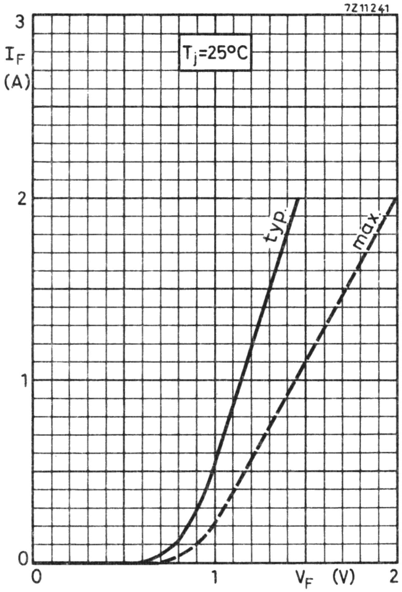
THERMAL RESISTANCE

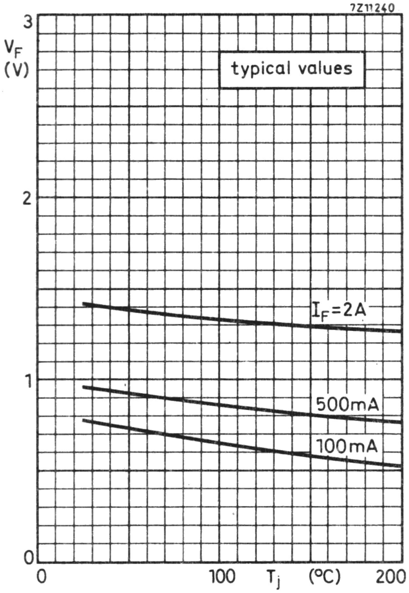
From junction to ambient in free air at maximum lead length	$R_{th\ j\text{-}a}$	=	0.3	$^oC/mW$

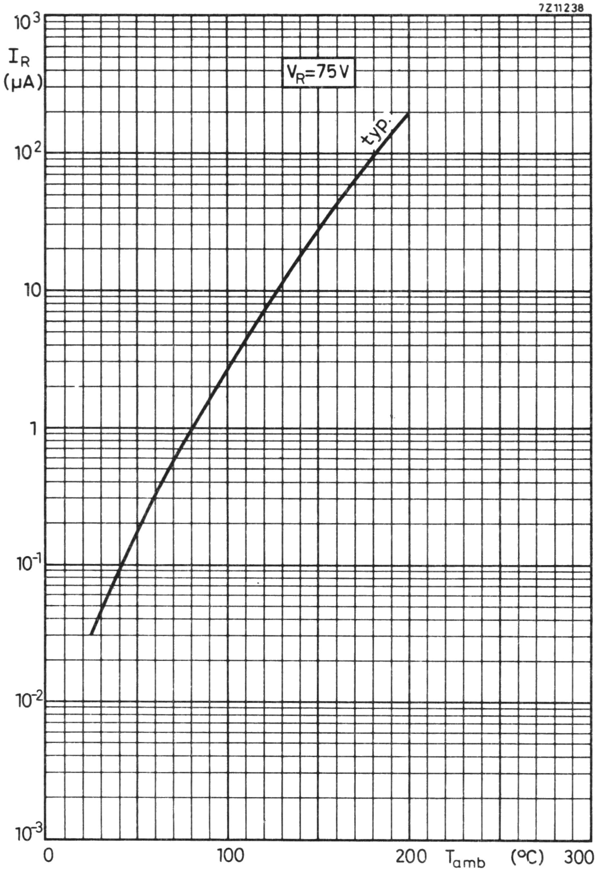
CHARACTERISTICS

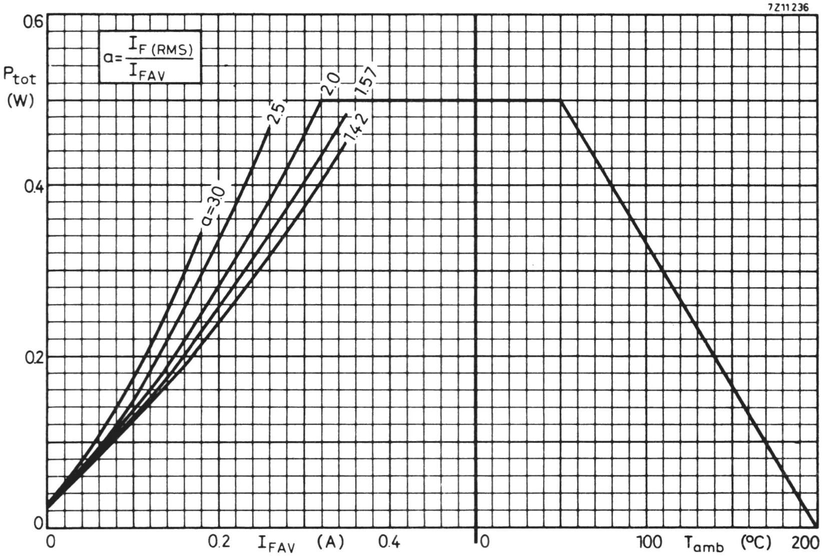
$T_j = 25\ ^oC$ unless otherwise specified

Forward voltage				
$I_F = 2$ A; $T_j = 150\ ^oC$	V_F	<	2.0	V
Reverse current				
$V_R = 75$ V; $T_j = 150\ ^oC$	I_R	<	100	μA


7Z11241
I_F
(A)
3
2
1
0
T_j=25°C
typ.
max.
0
1
V_F (V)
2


7Z11240
V_F
(V)
3
2
1
0
typical values
I_F=2A
500mA
100mA
0
100
T_j (°C)
200


7Z11238
10^3
I_R
(μA)
$V_R = 75\ V$
typ.
10^2
10
1
10^{-1}
10^{-2}
10^{-3}
0
100
200
T_{amb}
(°C)
300

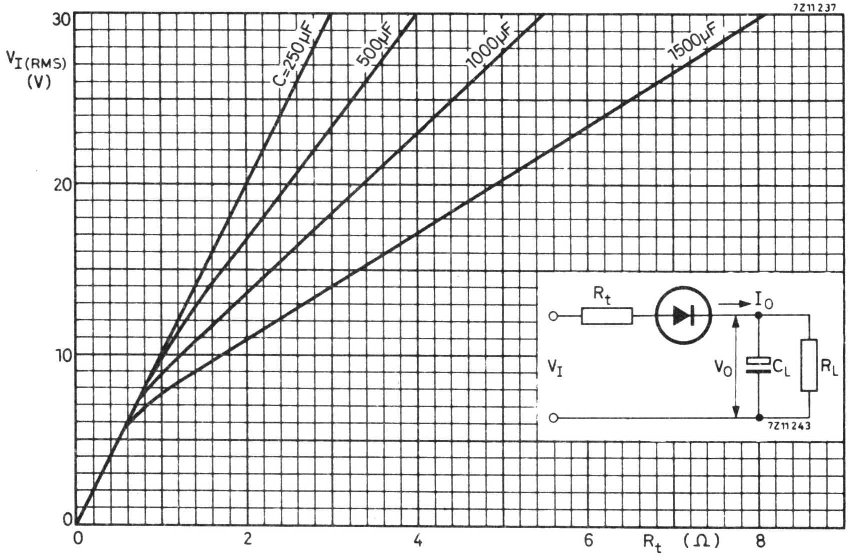


From the left hand graph the total power dissipation can be found as a function of the average output current.

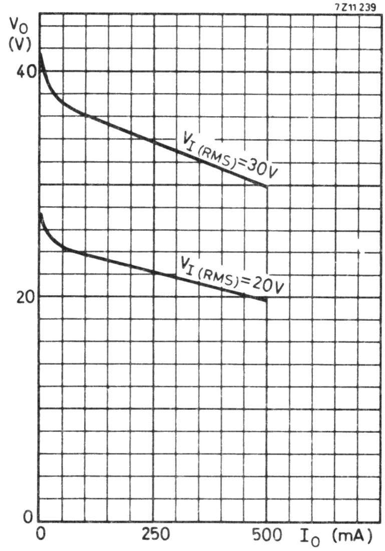
The parameter $a = \frac{I_{F(RMS)} \text{ per diode}}{I_{FAV} \text{ per diode}}$ depends on $n\omega R_L C_L$ and $\frac{R_t + R_{diff}}{nR_L}$ and can be found from existing graphs.

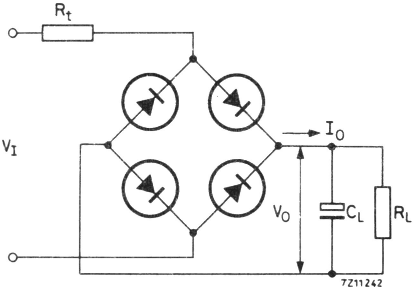
See Application Book: RECTIFIER DIODES.
Once the power dissipation is known, the max. permissible ambient temperature follows from the right hand graph.
For the series resistance, added to limit the initial peak rectifier current, the required minimum value can be found from the upper graph on page 6.
R_{diff} can be found from the left hand graph on the upper half of page 3.

Required minimum value of R_t
R_t includes the transformer resistance



V_O, I_O characteristics for the circuit shown




R_t
V_I
I_O
V_O
C_L
R_L
7Z11242

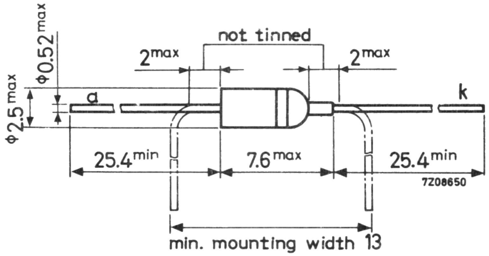
V_I	R_t	C_L
30 V	5.6 Ω	1000 µF
20 V	3.4 Ω	1000 µF

SILICON PLANAR EPITAXIAL DIODE

Silicon planar epitaxial diode in subminiature all glass DO-7 envelope.
The BAX78 is a diode, for very high speed high current applications, primarily intended for core gating in very fast memories.

MECHANICAL DATA Dimensions in mm

DO-7



The coloured band indicates the cathode

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages				
Continuous reverse voltage	V_R	max.	55	V [1]
Repetitive peak reverse voltage	V_{RRM}	max.	55	V
Currents				
Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	300	mA
Forward current (d.c.)	I_F	max.	300	mA
Repetitive peak forward current	I_{FRM}	max.	600	mA
Non repetitive peak forward current				
t = 1 μs	I_{FSM}	max.	2000	mA
t = 1 s	I_{FSM}	max.	600	mA
Temperatures				
Storage temperature	T_{stg}		−65 to +200	°C
Junction temperature	T_j	max.	190	°C

---

[1] Measured at zero lifetime: $I_R = 5\ \mu A$; $V_R > 65$ V

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.4 °C/mW

CHARACTERISTICS

$T_j = 25\ ^{\circ}C$ unless otherwise specified

Forward voltage				
$I_F = 1\ mA$	V_F		0.55 to 0.65	V
$I_F = 10\ mA$	V_F		0.65 to 0.75	V
$I_F = 100\ mA$	V_F		0.85 to 0.95	V
→ $I_F = 500\ mA$[1]	V_F		1.00 to 1.35	V
Reverse current				
$V_R = 55\ V$	I_R	<	100	nA
$V_R = 55\ V$; $T_j = 150\ ^{\circ}C$	I_R	<	100	μA
Diode capacitance				
$V_R = 0$; $f = 1\ MHz$	C_d	<	2	pF
Forward recovery voltage				
$I_F = 400\ mA$; $t_r = 30\ ns$	V_{FM}	<	2.0	V
$I_F = 400\ mA$; $t_r = 100\ ns$	V_{FM}	<	1.5	V
Recovered charge when switched from				
$I_F = 10\ mA$ to $V_R = 5\ V$; $R_L = 500\ \Omega$	Q_s	<	35	pC
Reverse recovery time when switched from				
$I_F = 400\ mA$ to $V_R = 40\ V$; $R_L = 1\ k\Omega$ measured at $I_R = 4\ mA$	t_{rr}	<	20	ns

FOR NEW DESIGN THE SUCCESSOR
TYPE BAV10 IS RECOMMENDED

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[1] Measured under pulsed conditions to avoid excessive dissipation.

SILICON PLANAR EPITAXIAL DIODE

This type has been superseded by the BAW62

GERMANIUM GOLD BONDED DIODE

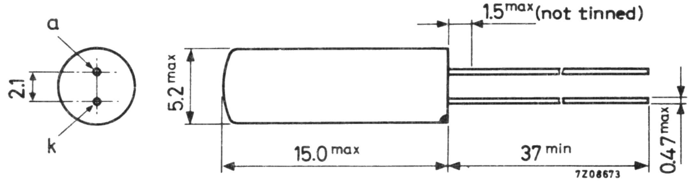
Germanium gold bonded diode in single ended all glass construction.

RATINGS (Limiting values) 1)			T_{amb} = 25 °C	T_{amb} = 75 °C	
Continuous reverse voltage	V_R	max.	100	50	V
Repetitive peak reverse voltage	V_{RRM}	max.	100	50	V
Average forward current	I_{FAV}	max.	125	50	mA
Repetitive peak forward current	I_{FRM}	max.	350	350	mA
Non rep. peak forw. current; $t < 1$ s	I_{FSM}	max.	500		mA
$t < 1$ μs; $\delta = 0.01$	I_{FSM}	max.	1000		mA
Operating ambient temperature	T_{amb}	max.		75	°C
Storage temperature	T_{stg}			−55 to +90	°C

CHARACTERISTICS		T_{amb} = 25 °C	T_{amb} = 60 °C	
Forward voltage				
I_F = 0.1 mA	V_F	0.10 to 0.25	0.03 to 0.20	V
I_F = 10 mA	V_F	0.25 to 0.55	0.20 to 0.50	V
I_F = 200 mA	V_F	0.50 to 1.0	0.48 to 1.0	V
I_F = 300 mA	V_F	0.55 to 1.25	0.55 to 1.25	V
Reverse current				
V_R = 1.5 V	I_R	0.2 to 5	5 to 26	μA
V_R = 10 V	I_R	0.3 to 6	5.5 to 30	μA
V_R = 50 V	I_R	0.45 to 9	7.5 to 60	μA
V_R = 100 V	I_R	0.7 to 30	10 to 120	μA

MECHANICAL DATA

Dimensions in mm



The red dot indicates the cathode side

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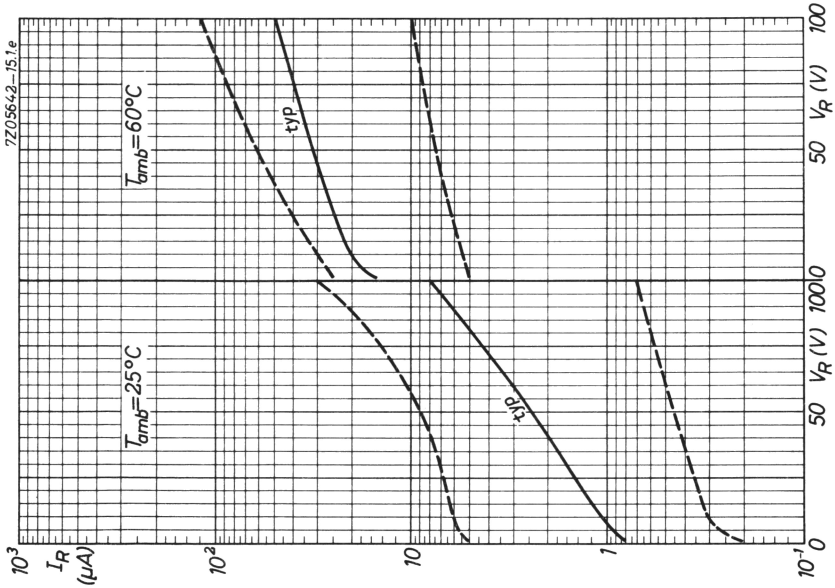
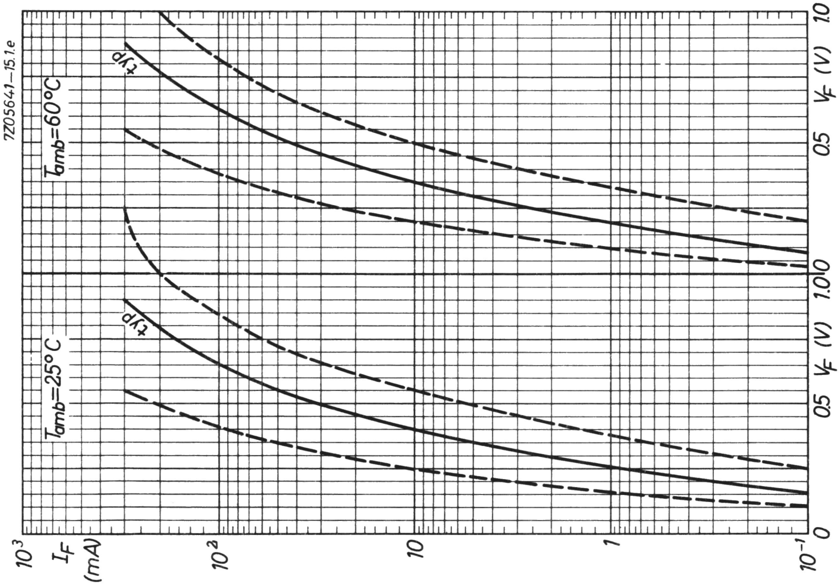
1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.





FOR NEW DESIGN THE SUCCESSOR TYPES
AAZ15, AAZ18 OR BAV10 ARE RECOMMENDED

GERMANIUM GOLD BONDED DIODE

Germanium gold bonded diode in single ended all glass construction intended for switching applications.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Continuous reverse voltage		V_R	max.	25	V
Repetitive peak reverse voltage		V_{RRM}	max.	25	V
Non-repetitive peak reverse voltage ($t \leq 1$ s)		V_{RSM}	max.	30	V
Average forward current;	T_{amb} = 25 °C	$I_{F(AV)}$	max.	80	mA
	T_{amb} = 75 °C	$I_{F(AV)}$	max.	40	mA
Forward current (d.c.)	T_{amb} = 25 °C	I_F	max.	140	mA
	T_{amb} = 75 °C	I_F	max.	50	mA
Repetitive peak forward current		I_{FRM}	max.	250	mA
Non-repetitive peak forward current ($t < 1$ s)		I_{FSM}	max.	400	mA
Operating ambient temperature		T_{amb}	max.	75	°C
Storage temperature		T_{stg}		−55 to +75	°C

THERMAL RESISTANCE

From junction to ambient	$R_{th\ j\text{-}a}$	=	0.4	°C/mW

CHARACTERISTICS

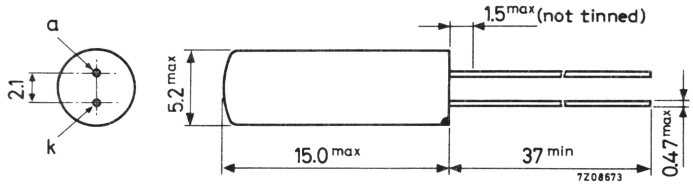
			T_{amb} = 25 °C	T_{amb} = 60 °C	
Forward voltage	I_F = 0.1 mA	V_F	0.12 to 0.26	0.06 to 0.19	V
	I_F = 10 mA	V_F	0.30 to 0.48	0.25 to 0.43	V ←
	I_F = 50 mA	V_F	0.40 to 0.78	0.37 to 0.75	V
	I_F = 250 mA	V_F	< 1.65	-	V
Reverse current	V_R = 1.5 V	I_R	typ. 0.4	< 20	µA
	V_R = 10 V	I_R	typ. 1.5	< 30	µA
	V_R = 25 V	I_R	typ. 6.0	< 150	µA

Reverse recovery current when switched from I_F = 5 mA to V_R = 5 V; T_{amb} = 25 °C measured at t_{rr} = 0.5 µs

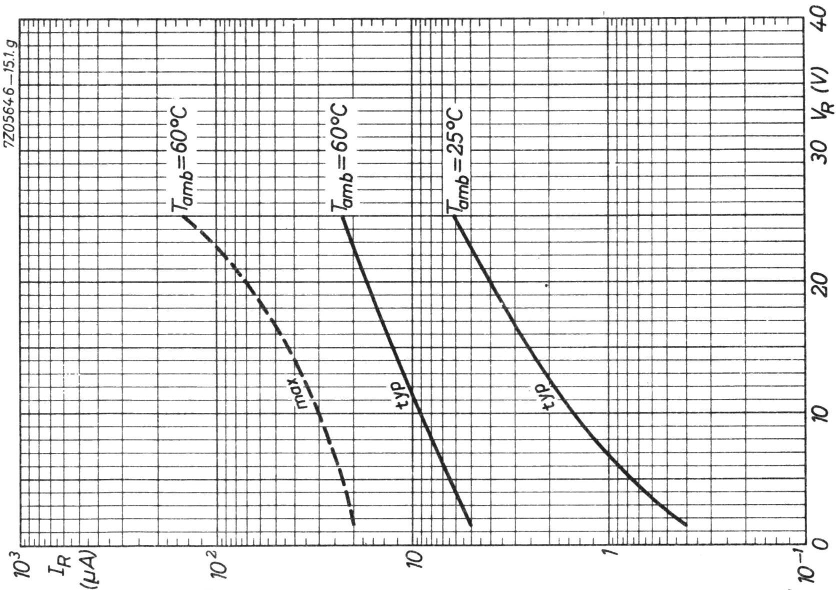
I_R	typ.	140	µA
	<	250	µA

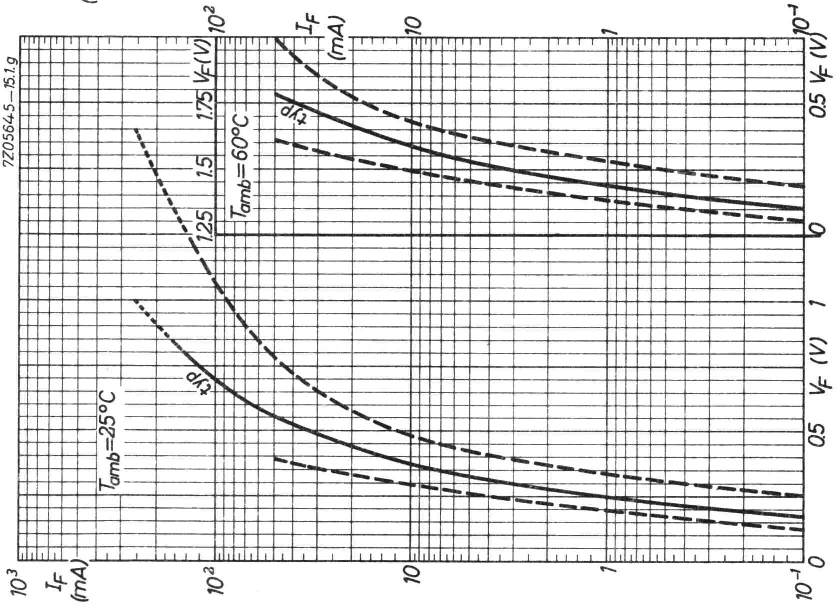
MECHANICAL DATA

Dimensions in mm



The red dot indicates the cathode





FOR NEW DESIGN THE SUCCESSOR TYPES
AAZ15, AAZ18 OR BAV10 ARE RECOMMENDED

GERMANIUM GOLD BONDED DIODE

Germanium gold bonded diode in single ended all glass construction intended for switching applications.

RATINGS (Limiting values)

Continuous reverse voltage	V_R	max.	25	V
Repetitive peak reverse voltage	V_{RRM}	max.	25	V
Non repetitive peak reverse voltage ($t \leq 1$ s)	V_{RSM}	max.	40	V
Average forward current: T_{amb} = 25 °C	I_{FAV}	max.	160	mA
T_{amb} = 75 °C	I_{FAV}	max.	70	mA
Forward current (d.c.) T_{amb} = 25 °C	I_F	max.	270	mA
T_{amb} = 75 °C	I_F	max.	90	mA
Repetitive peak forward current	I_{FRM}	max.	500	mA
Non repetitive peak forward current ($t < 1$ s)	I_{FSM}	max.	800	mA
Operating ambient temperature	T_{amb}	max.	75	°C
Storage temperature	T_{stg}		−55 to +90	°C

THERMAL RESISTANCE

From junction to ambient $R_{th\ j\text{-}a}$ = 0.35 °C/mW

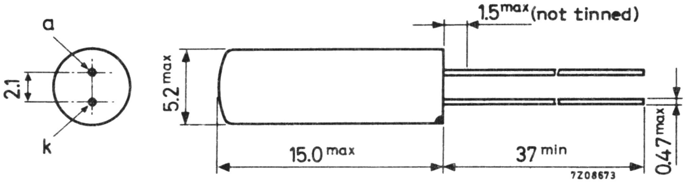
CHARACTERISTICS

			T_{amb} = 25 °C	T_{amb} = 60 °C	
Forward voltage	I_F = 0.1 mA	V_F	< 0.21	< 0.15	V
	I_F = 10 mA	V_F	< 0.41	< 0.35	V
	I_F = 500 mA	V_F	< 0.90		V
Reverse current	V_R = 1.5 V	I_R	< 3.5	< 20	µA
	V_R = 10 V	I_R	< 10	< 45	µA
	V_R = 25 V	I_R	< 50	< 100	µA

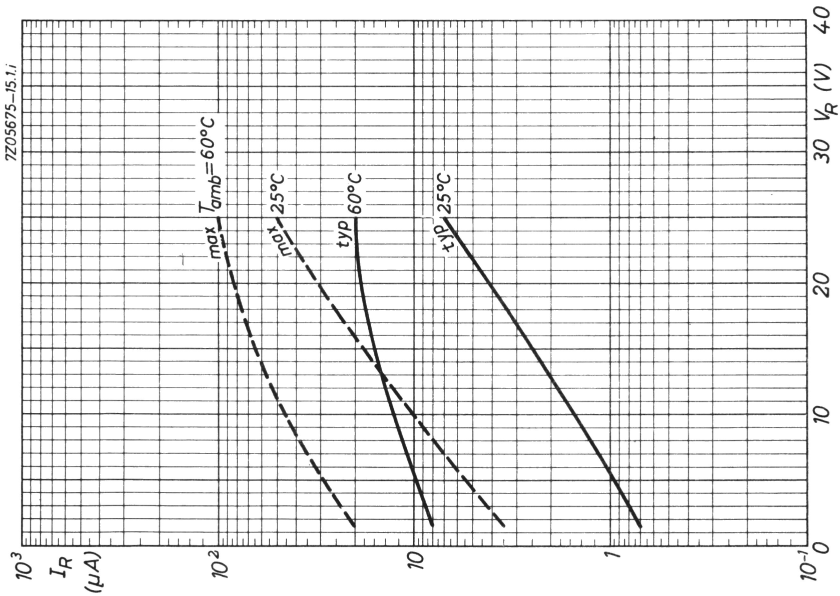
Reverse recovery current when switched
from I_F = 400 mA to V_R = 10 V; T_{amb} = 25 °C
measured at t_{rr} = 3.5 µs I_R < 150 µA

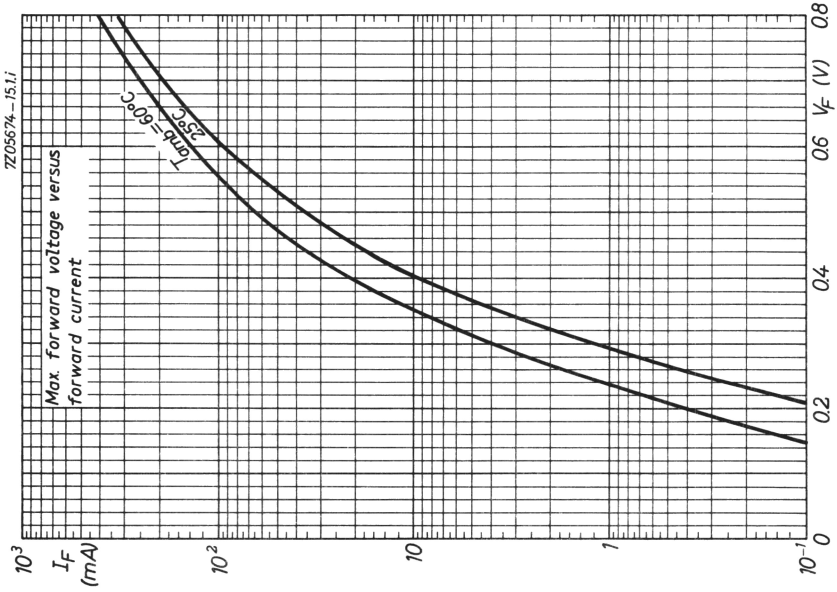
MECHANICAL DATA

Dimensions in mm



The red dot indicates the cathode side





FOR NEW DESIGN THE SUCCESSOR TYPES
AAZ15, AAZ18 OR BAV10 ARE RECOMMENDED

GOLD BONDED DIODE

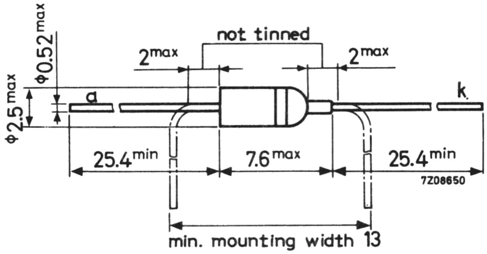
Gold bonded germanium diode in subminiature all glass DO-7 envelope, intended for switching applications and general purposes.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	25	V
Repetitive peak reverse voltage	V_{RRM}	max.	25	V
Forward current (d.c.)	I_F	max.	110	mA
Repetitive peak forward current	I_{FRM}	max.	150	mA
Junction temperature	T_j	max.	75	^oC
Forward voltage at I_F = 150 mA	V_F	<	1.1	V
Recovered charge when switched from I_F = 10 mA to V_R = 10 V	Q_s	<	600	pC

MECHANICAL DATA

Dimensions in mm

DO-7


ϕ0.52max
not tinned
2max
2max
ϕ2.5max
a
k
25.4min
7.6max
25.4min
7Z08650
min. mounting width 13

The coloured band indicates the cathode

RATINGS (Limiting values) [1]

Voltages

Continuous reverse voltage	V_R	max.	25	V
Repetitive peak reverse voltage	V_{RRM}	max.	25	V
Non repetitive peak reverse voltage ($t < 1$ s)	V_{RSM}	max.	30	V

Currents

Forward current (d.c.)	I_F	max.	110	mA
Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	110	mA
Repetitive peak forward current	I_{FRM}	max.	150	mA
Non repetitive peak forward current ($t < 1$ s)	I_{FSM}	max.	200	mA

Temperatures

Storage temperature	T_{stg}		−65 to +75	°C
Junction temperature	T_j	max.	75	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\,j\text{-}a}$	=	0.45	°C/mW

---

[1] Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

CHARACTERISTICS

Forward voltage at $T_j = 25\ ^{o}C$

$I_F = 0.1$ mA	$V_F < 0.20$ V
$I_F = 1.0$ mA	$V_F < 0.31$ V
$I_F = 10$ mA	$V_F < 0.45$ V
$I_F = 30$ mA	$V_F < 0.65$ V
$I_F = 150$ mA	$V_F < 1.10$ V

Forward voltage at $T_j = 60\ ^{o}C$

$I_F = 0.1$ mA	$V_F < 0.14$ V
$I_F = 1.0$ mA	$V_F < 0.28$ V
$I_F = 10$ mA	$V_F < 0.43$ V
$I_F = 30$ mA	$V_F < 0.62$ V
$I_F = 150$ mA	$V_F < 1.10$ V

Reverse current at $T_j = 25\ ^{o}C$

$V_R = 1.5$ V	$I_R < 3.5\ \mu A$
$V_R = 10$ V	$I_R < 15\ \mu A$
$V_R = 20$ V	$I_R < 50\ \mu A$
$V_R = 25$ V	$I_R < 100\ \mu A$

Reverse current at $T_j = 60\ ^{o}C$

$V_R = 1.5$ V	$I_R < 20\ \mu A$
$V_R = 10$ V	$I_R < 40\ \mu A$
$V_R = 20$ V	$I_R < 90\ \mu A$
$V_R = 25$ V	$I_R < 160\ \mu A$

Diode capacitance

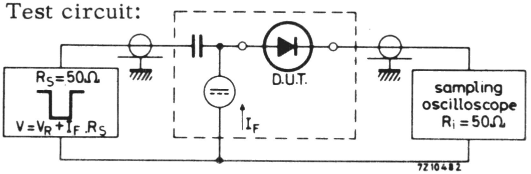
$V_R = 1$ V; $f = 1$ MHz	$C_d < 3.5$ pF

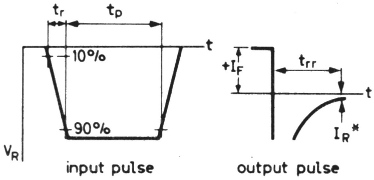
CHARACTERISTICS (continued) $T_j = 25\ ^{o}C$

Reverse recovery time when switched
from $I_F = 10$ mA to $V_R = 1$ V; $R_L = 100\ \Omega$

Measured at $I_R = 10\ \%$ of $\frac{V_R}{R_L}$ t_{rr} < 70 ns

Test circuit:


R$_S$=50Ω
V=V$_R$+I$_F$.R$_S$
D.U.T.
I$_F$
sampling
oscilloscope
R$_i$=50Ω
7Z10482


t$_r$
t$_p$
t
10%
90%
V$_R$
input pulse
+I$_F$
t$_{rr}$
t
I$_R$*
output pulse

*) $I_R = 10\ \%$ of $\frac{V_R}{R_L}$

Reverse pulse: Rise time t_r = 0.6 ns

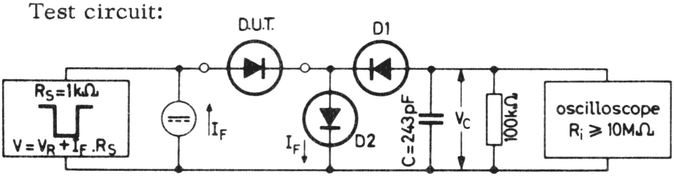
Pulse duration t_p = 100 ns

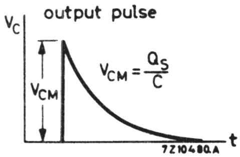
Duty cycle δ = 0.05

Circuit capacitance $C < 1$ pF (C = Oscilloscope + parasitical capacitance)

Recovered charge when switched
from $I_F = 10$ mA to $V_R = 10$ V; $R_L = 1$ kΩ Q_s < 600 pC

Test circuit:


D.U.T.
D1
R$_S$=1kΩ
V=V$_R$+I$_F$.R$_S$
I$_F$
I$_F$
D2
C=243pF
V$_C$
100kΩ
oscilloscope
R$_i$ ≥ 10MΩ


V$_C$
output pulse
V$_{CM}$
V$_{CM}$ = $\frac{Q_S}{C}$
t
7Z10480.A

D1 = D2 = BAW62

Reverse pulse: Rise time t_r = 2 ns

Pulse duration t_p = 0.4 μs

Duty cycle δ = 0.02

POINT CONTACT DIODES

OA70: this type has been superseded by the OA90

OA72: this type has been superseded by the AA119

OA73: this type has been superseded by the AA119

POINT CONTACT DIODES

OA79: this type has been superseded by the AA119

OA81: this type has been superseded by the OA91

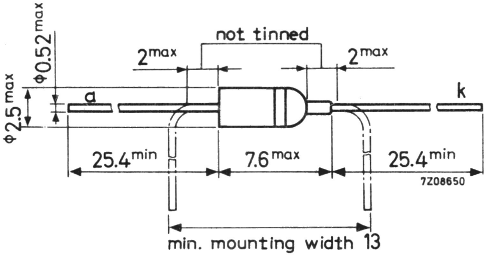
OA85: this type has been superseded by the OA95

POINT CONTACT DIODE

Germanium diode in subminiature all glass DO-7 construction for use as video detector.

MECHANICAL DATA Dimensions in mm

DO-7



The coloured band indicates the cathode

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

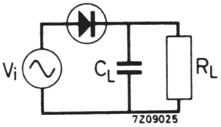
Average reverse voltage (averaged over any 50 ms period)	V_R	max.	20	V
Repetitive peak reverse voltage	V_{RRM}	max.	30	V
Non repetitive peak reverse voltage	V_{RSM}	max.	40	V
Average forward current (averaged over any 50 ms period)	I_F	max.	8	mA
Repetitive peak forward current	I_{FRM}	max.	45	mA
Non repetitive peak forward current ($t < 1$ s)	I_{FSM}	max.	200	mA
Storage temperature	T_{stg}		−55 to +90	°C
Operating ambient temperature	T_{amb}		−55 to +75	°C

CHARACTERISTICS

		T_{amb} = 25 °C	60 °C	
Forward voltage				
I_F = 0.1 mA	V_F	typ. 0.18	typ. 0.12	V
		0.1 to 0.25	< 0.20	V
I_F = 10 mA	V_F	typ. 1.0	typ. 0.95	V
		0.5 to 1.5	0.4 to 1.4	V
I_F = 30 mA	V_F	typ. 2.0	typ. 1.95	V
		1.1 to 3.2	1.0 to 3.1	V
Reverse current				
V_R = 1.5 V	I_R	typ. 2.4	typ. 11	μA
		< 10	< 40	μA
V_R = 10 V	I_R	typ. 20	typ. 45	μA
		< 135	< 270	μA
V_R = 20 V	I_R	typ. 90	typ. 140	μA
		< 450	< 650	μA
V_R = 30 V	I_R	typ. 300	typ. 400	μA
		< 1100	< 1500	μA

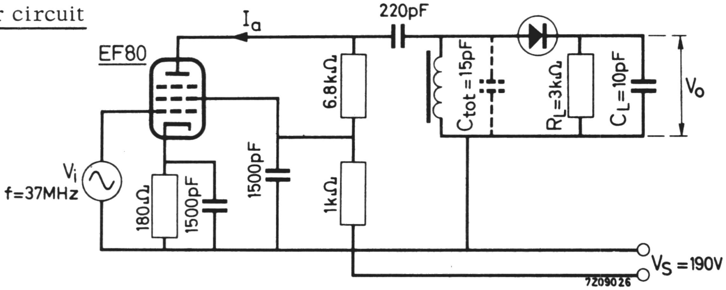
APPLICATION INFORMATION

Measuring circuit


V$_i$
C$_L$
R$_L$
7Z09025

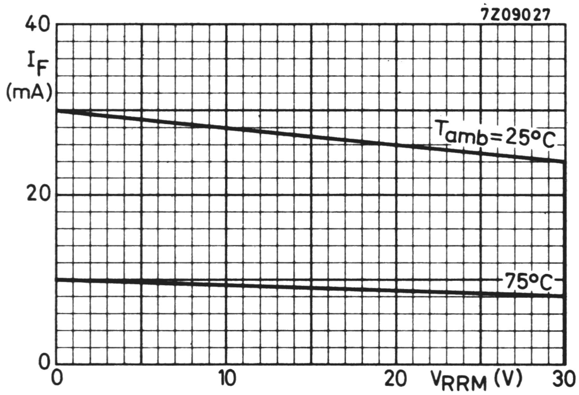
V_{im}	=	5	1.4	0.5	5	V
f	=	40	40	40	30	MHz
C_L	=	10	10	10	10	pF
R_L	=	3	3	3	3.9	kΩ
η	typ.	63	54	34	>60	%
R_d	typ.	2.4	2.8	3.7	>2.9	kΩ

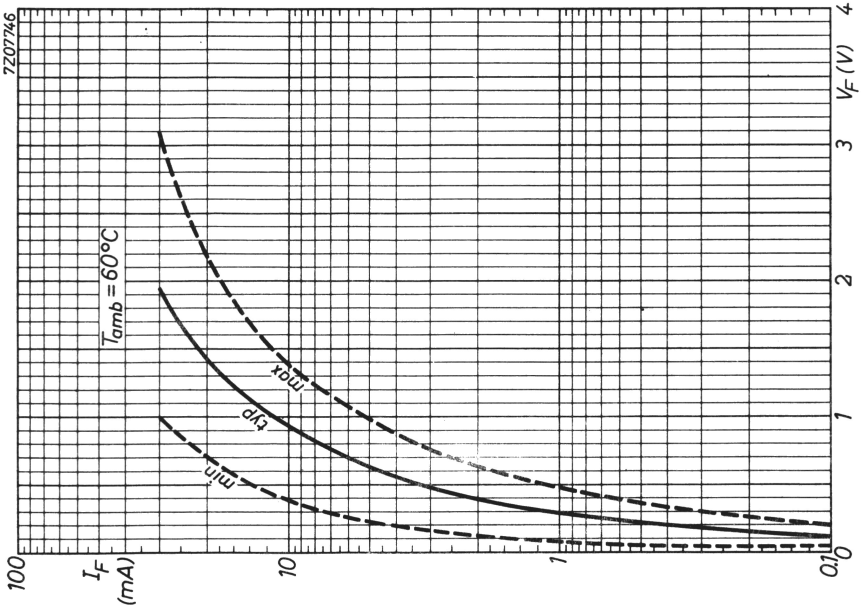
Video detector circuit

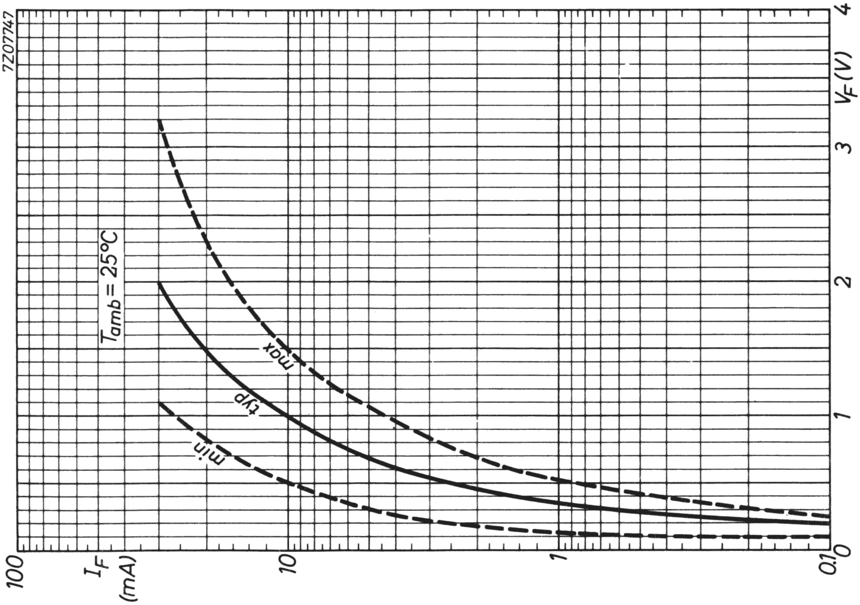

I$_a$
220pF
EF80
6.8kΩ
C$_{tot}$ =15pF
R$_L$=3kΩ
C$_L$=10pF
V$_o$
V$_i$
f=37MHz
180Ω
1500pF
1500pF
1kΩ
V$_S$ =190V
7Z09026

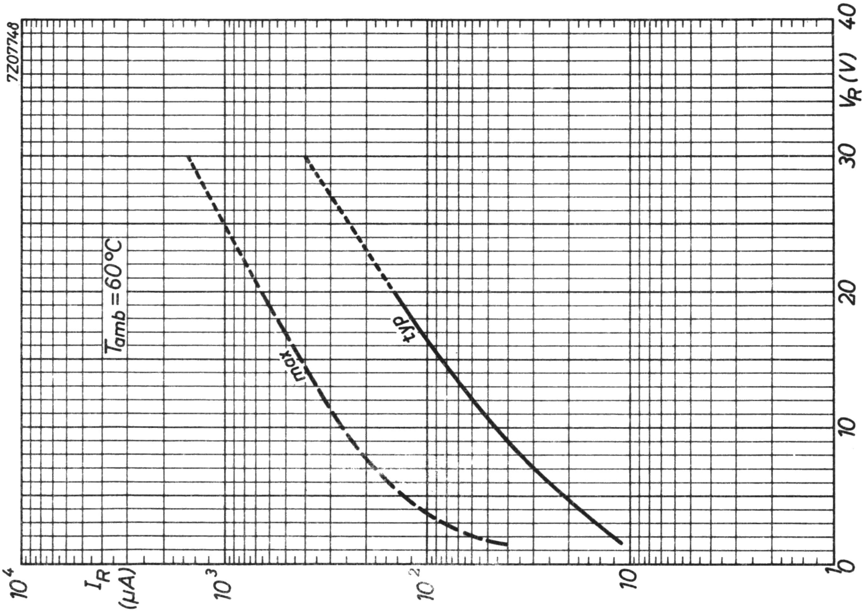
Q of the tuned circuit with removed diode: Q = 19

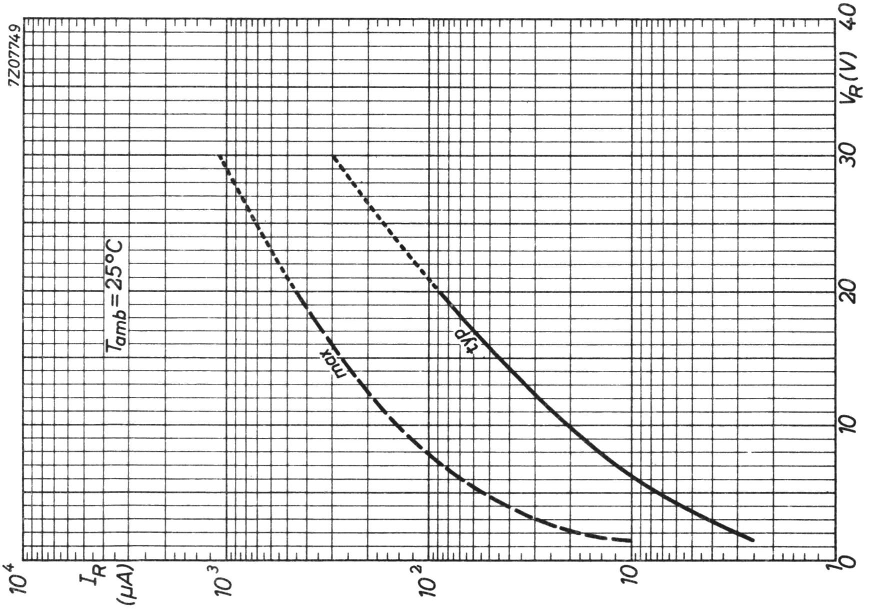
I_{am}	=	2.5	0.25	mA
B	=	4.7	4.1	MHz
V_o	typ.	2.7	0.20	V

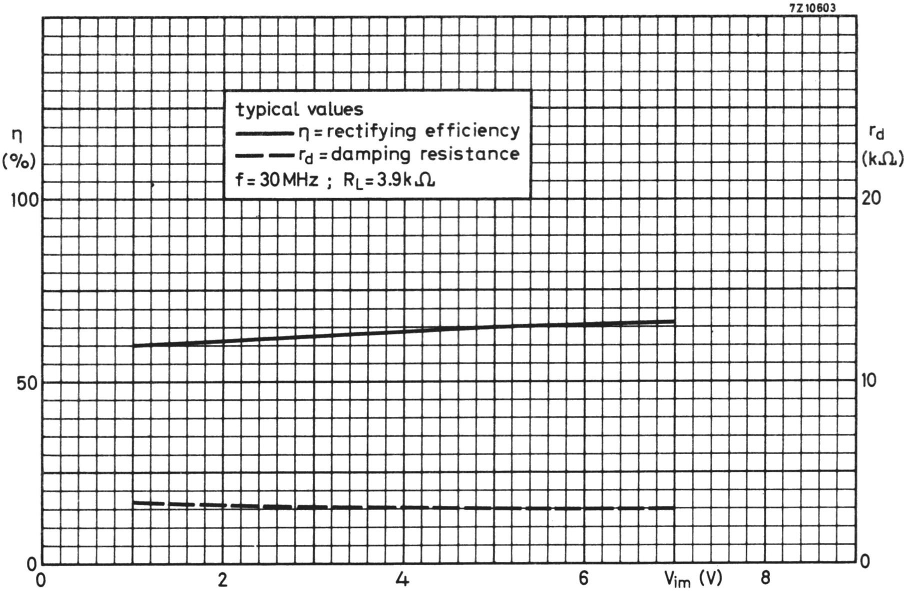



7Z07746
$T_{amb} = 60°C$
max
typ
min
I_F (mA)
100
10
1
0.1
V_F (V)
0
1
2
3
4


7Z07747
$T_{amb} = 25°C$
max
typ
min
I_F (mA)
100
10
1
0.1
V_F (V)
0
1
2
3
4


7Z07748
T_{amb} = 60°C
max
typ
I_R (μA)
10^4
10^3
10^2
10
1
V_R (V)
0
10
20
30
40


7Z07749
T_{amb} = 25°C
max
typ
I_R (μA)
10^4
10^3
10^2
10
1
V_R (V)
0
10
20
30
40


7Z10603
typical values
η = rectifying efficiency
r_d = damping resistance
f = 30 MHz ; R_L = 3.9 kΩ
η
(%)
100
50
0
r_d
(kΩ)
20
10
0
0
2
4
6
V_im (V)
8

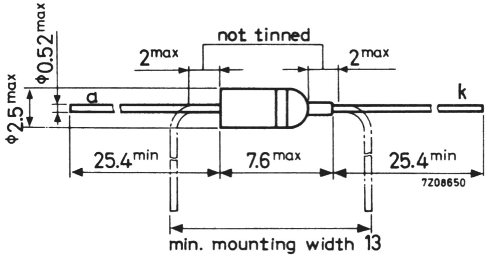
POINT CONTACT DIODE

Germanium diode in subminiature all glass DO-7 construction for general purposes.

MECHANICAL DATA

Dimensions in mm

DO-7



The coloured band indicates the cathode

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

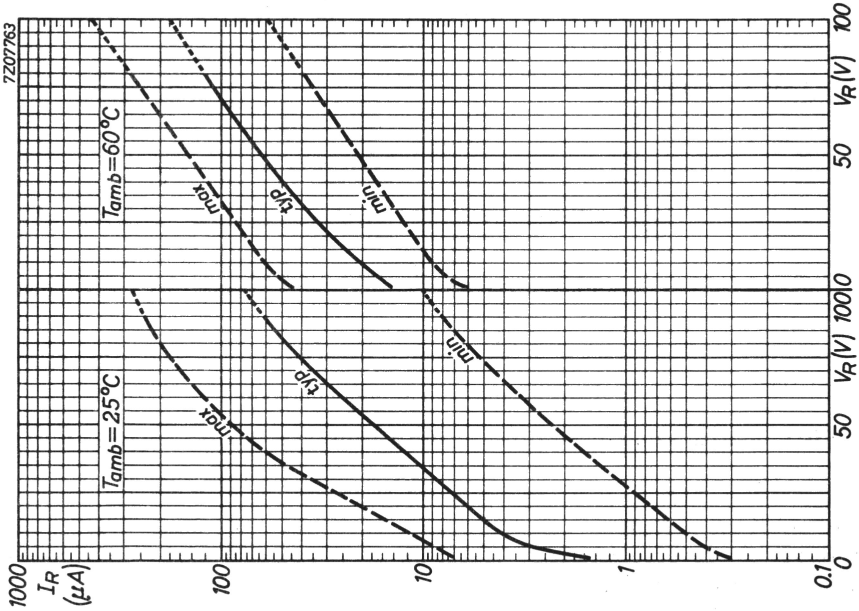
Average reverse voltage (averaged over any 50 ms period)	V_R	max.	90	V
Repetitive peak reverse voltage	V_{RRM}	max.	115	V
Average forward current (averaged over any 50 ms period)	I_F	max.	50	mA
Repetitive peak forward current	I_{FRM}	max.	150	mA
Non repetitive peak forward current ($t < 1$ s)	I_{FSM}	max.	500	mA
Storage temperature	T_{stg}		−55 to +75	°C
Operating ambient temperature	T_{amb}		−55 to +75	°C

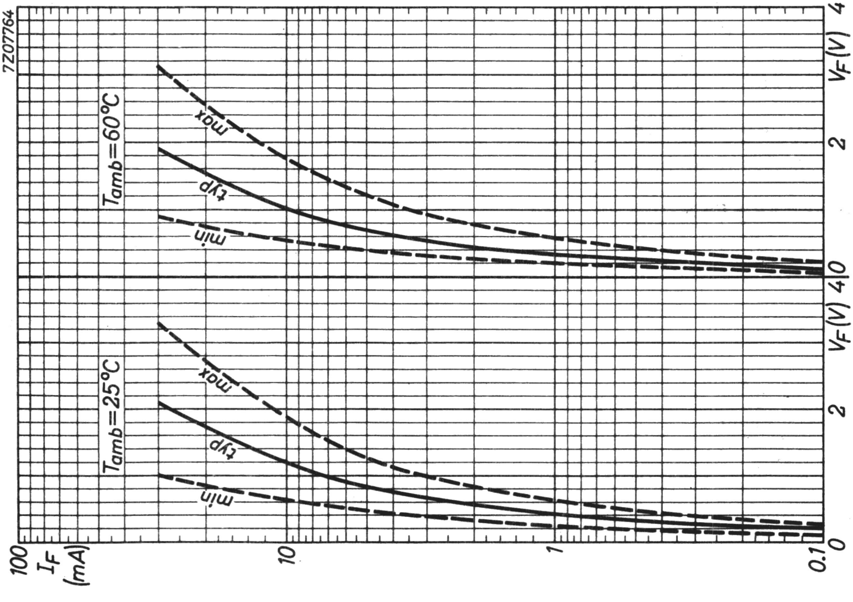
THERMAL RESISTANCE

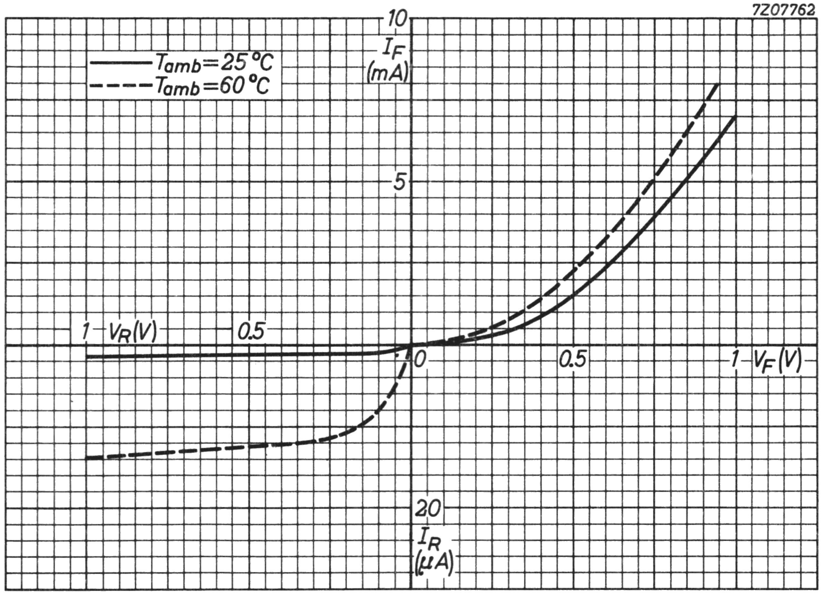
From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.4	°C/mW

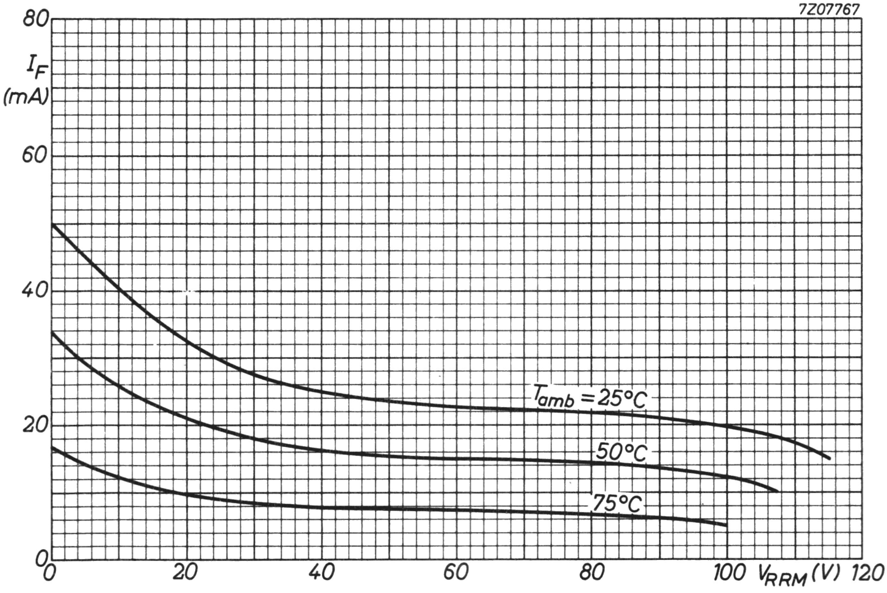
CHARACTERISTICS

		$T_{amb} = 25$ °C	$T_{amb} = 60$ °C	
Forward voltage				
$I_F = 0.1$ mA	V_F	typ. 0.18	typ. 0.1	V
		0.1 to 0.25	0.05 to 0.2	V
$I_F = 10$ mA	V_F	typ. 1.2	typ. 1.05	V
		0.65 to 1.9	0.55 to 1.8	V
$I_F = 30$ mA	V_F	typ. 2.1	typ. 1.9	V
		1.0 to 3.3	0.9 to 3.15	V
Reverse current				
$V_R = 1.5$ V	I_R	typ. 1.5	typ. 15	μA
		0.3 to 7	6 to 45	μA
$V_R = 10$ V	I_R	typ. 4	typ. 20	μA
		0.5 to 11	9 to 60	μA
$V_R = 75$ V	I_R	typ. 40	typ. 115	μA
		5.5 to 180	35 to 260	μA
$V_R = 100$ V	I_R	typ. 75	typ. 190	μA
		10 to 275	60 to 450	μA


7Z07763
Tamb=60°C
Tamb=25°C
max
typ
min
I_R (µA)
1000
100
10
1
0.1
V_R(V)
0
50
100


7Z07764
Tamb=60°C
Tamb=25°C
max
typ
min
I_F (mA)
100
10
1
0.1
V_F(V)
0
2
4


7Z07762
10
I_F
(mA)
5
$T_{amb}=25\,°C$
$T_{amb}=60\,°C$
1
V_R(V)
0.5
0
0.5
1
V_F(V)
20
I_R
(μA)


7Z07767
80
I_F
(mA)
60
40
20
0
0
20
40
60
80
100
V_{RRM}(V)
120
$T_{amb}=25°C$
50°C
75°C

POINT CONTACT DIODE

Germanium diode in subminiature all glass DO-7 envelope, intended for switching applications.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Continuous reverse voltage	V_R	max.	15	V
Repetitive peak reverse voltage	V_{RRM}	max.	15	V
Non repetitive peak reverse voltage ($t < 1$ s)	V_{RSM}	max.	20	V
Average forward current	I_{FAV}	max.	7	mA
Forward current (d.c.)	I_F	max.	10	mA
Repetitive peak forward current	I_{FRM}	max.	50	mA
Non repetitive peak forward current ($t < 1$ s)	I_{FSM}	max.	100	mA
Operating ambient temperature	T_{amb}	max.	75	°C
Storage temperature	T_{stg}		−55 to +90	°C

THERMAL RESISTANCE

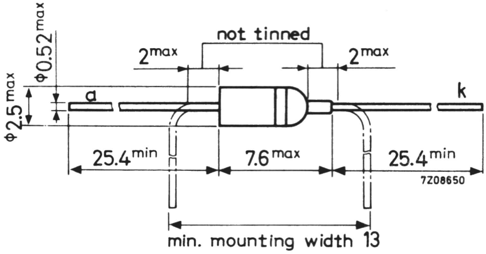
From junction to ambient	$R_{th\,j\text{-}a}$	=	0.55	°C/mW

CHARACTERISTICS

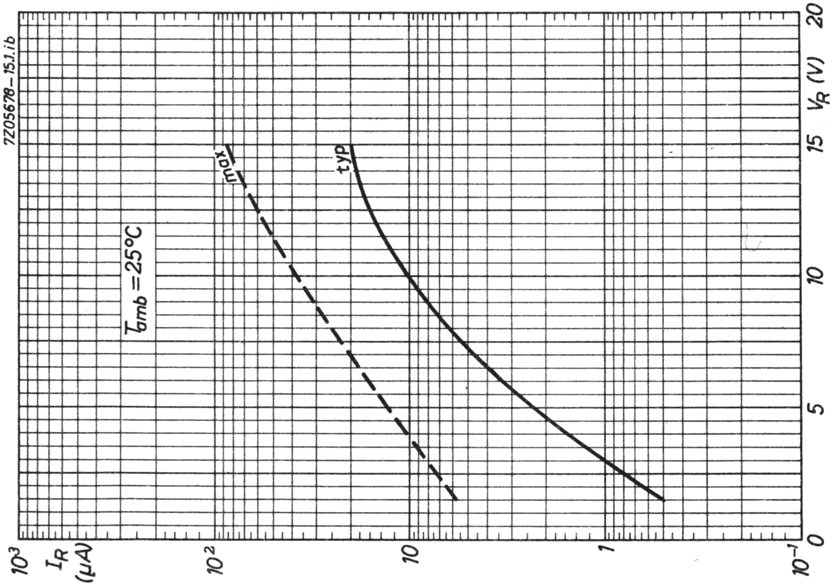
Forward voltage at T_{amb} = 25 °C I_F = 3 mA	V_F	typ. 0.30 to	0.55 1.00	V V
Reverse current at T_{amb} = 60 °C V_R = 15 V	I_R	typ. <	40 155	μA μA
Reverse recovery current when switched from I_F = 5 mA to V_R = 5 V; T_{amb} = 25 °C measured at t_{rr} = 0.5 μs	I_R	typ. <	80 300	μA μA
measured at t_{rr} = 3.5 μs	I_R	typ. <	15 60	μA μA
Diode capacitance at f = 0.5 MHz V_R = 0.75 V; T_{amb} = 25 °C	C_d	<	0.5	pF

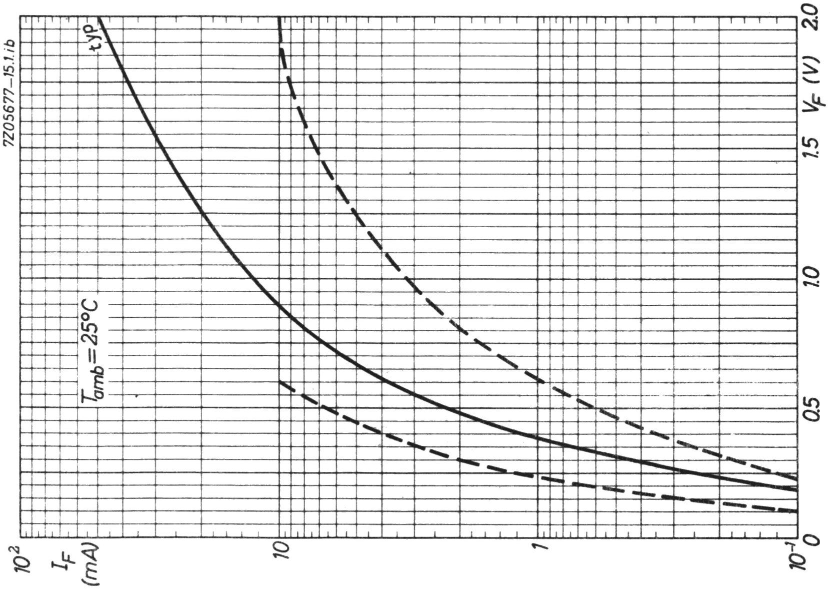
MECHANICAL DATA Dimensions in mm

DO-7



The coloured band indicates the cathode


7Z05678-15.1.ib
$T_{amb} = 25°C$
max
typ
10^3
I_R
(μA)
10^2
10
1
10^{-1}
0
5
10
15
20
V_R (V)

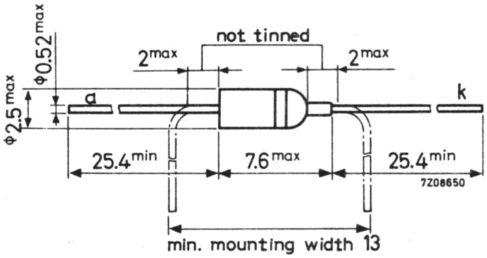

7Z05677-15.1.ib
typ
$T_{amb} = 25°C$
10^2
I_F
(mA)
10
1
10^{-1}
0
0.5
1.0
1.5
2.0
V_F (V)

POINT CONTACT DIODE

Germanium diode in subminiature all glass DO-7 construction for general purposes.

MECHANICAL DATA Dimensions in mm

DO-7



The coloured band indicates the cathode

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

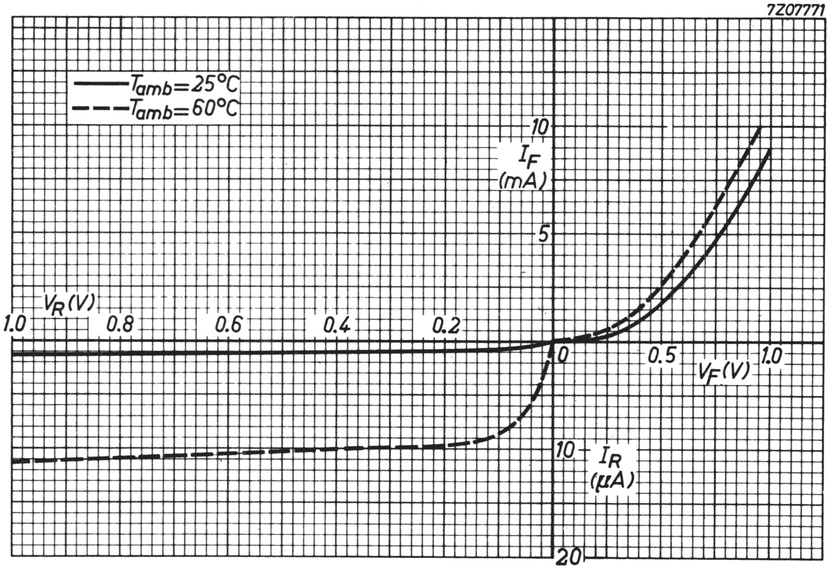
Average reverse voltage (averaged over any 50 ms period)	V_R	max.	90	V
Repetitive peak reverse voltage	V_{RRM}	max.	115	V
Average forward current (averaged over any 50 ms period)	I_F	max.	50	mA
Repetitive peak forward current	I_{FRM}	max.	150	mA
Non repetitive peak forward current ($t < 1$ s)	I_{FSM}	max.	500	mA
Storage temperature	T_{stg}		−55 to +75	°C
Operating ambient temperature	T_{amb}		−55 to +75	°C

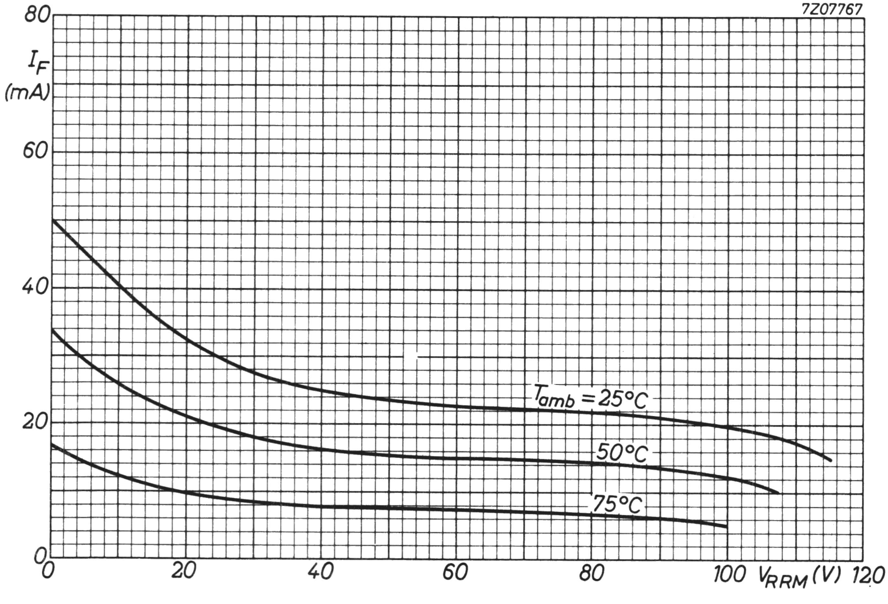
THERMAL RESISTANCE

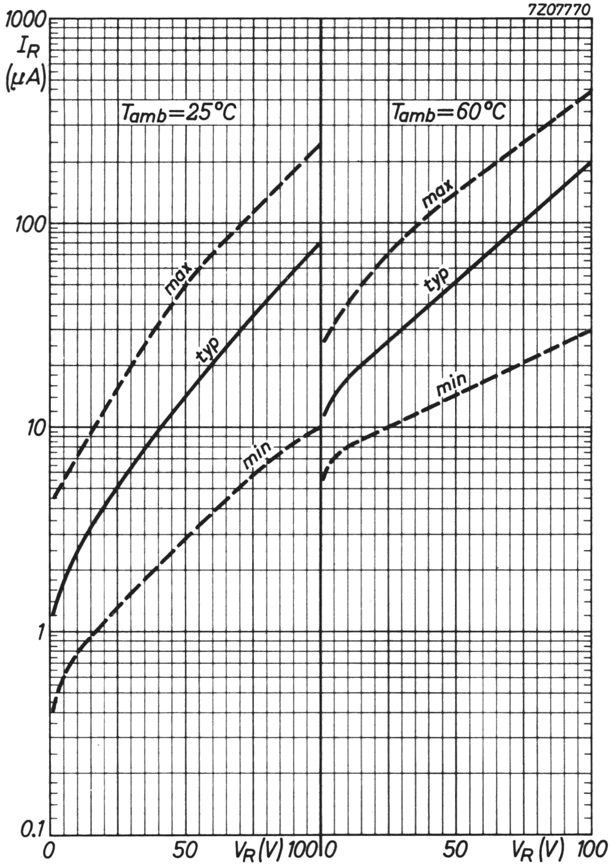
From junction to ambient in free air $R_{th\ j\text{-}a}$ = 0.4 °C/mW

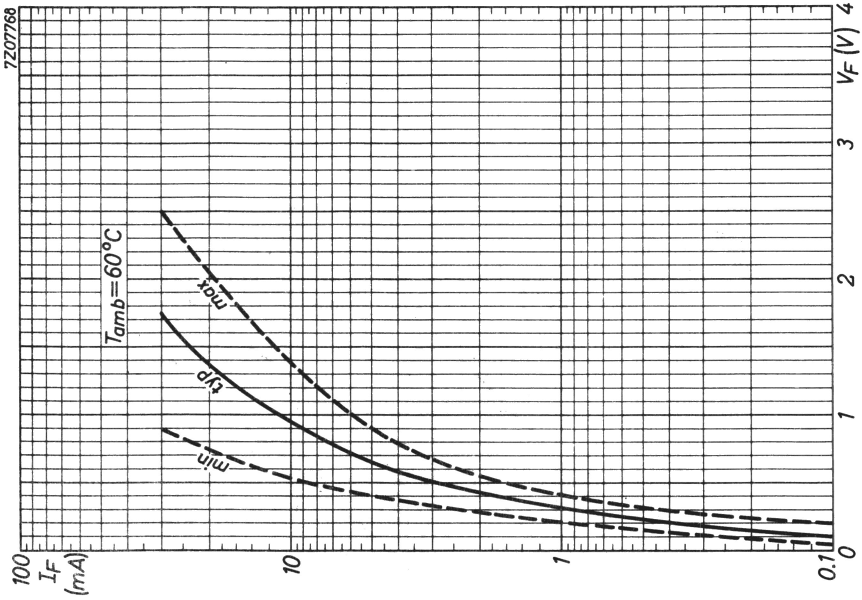
CHARACTERISTICS

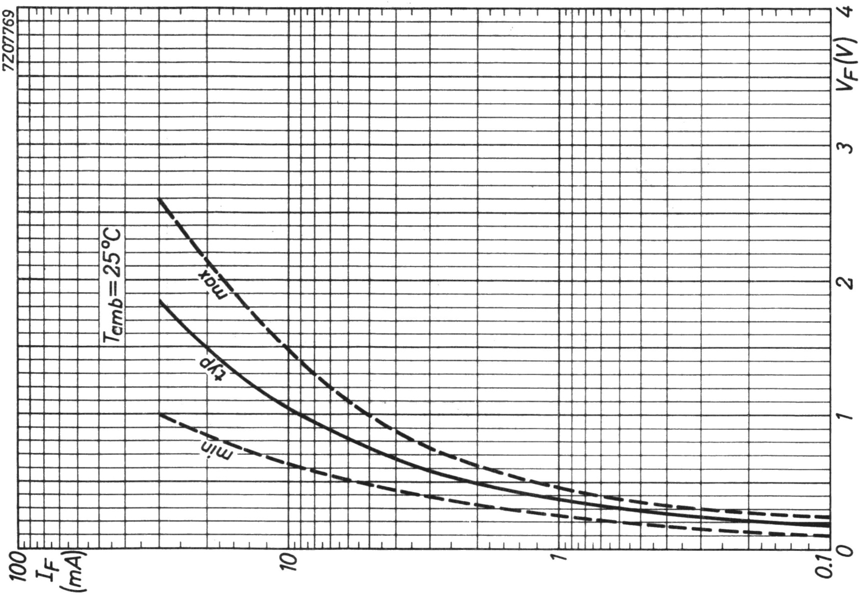
		T_{amb} = 25 °C	T_{amb} = 60 °C	
Forward voltage				
I_F = 0.1 mA	V_F	typ. 0.18	typ. 0.1	V
		0.1 to 0.25	0.05 to 0.2	V
I_F = 10 mA	V_F	typ. 1.05	typ. 0.95	V
		0.65 to 1.5	0.55 to 1.4	V
I_F = 30 mA	V_F	typ. 1.85	typ. 1.75	V
		1.0 to 2.6	0.9 to 2.5	V
Reverse current				
V_R = 1.5 V	I_R	typ. 1.2	typ. 12	μA
		0.4 to 4.5	5.5 to 26	μA
V_R = 10 V	I_R	typ. 2.5	typ. 17	μA
		0.8 to 7	8 to 40	μA
V_R = 75 V	I_R	typ. 35	typ. 100	μA
		5.7 to 110	20 to 250	μA
V_R = 100 V	I_R	typ. 80	typ. 200	μA
		10 to 250	30 to 430	μA


7Z07771
T_{amb} = 25°C
T_{amb} = 60°C
10
I_F
(mA)
5
V_R (V)
1.0
0.8
0.6
0.4
0.2
0
0.5
1.0
V_F (V)
10
I_R
(μA)
20


7Z07767
80
I_F
(mA)
60
40
20
0
0
20
40
60
80
100
V_{RRM} (V)
120
T_{amb} = 25°C
50°C
75°C


7Z07770
1000
I_R
(μA)
100
10
1
0.1
T_{amb}=25°C
T_{amb}=60°C
max
typ
min
max
typ
min
0
50
V_R(V)
100
0
50
V_R(V)
100


7Z07768
T_{amb}=60°C
max
typ
min
I_F (mA)
100
10
1
0.1
V_F (V)
0
1
2
3
4


7Z07769
T_{amb}=25°C
max
typ
min
I_F (mA)
100
10
1
0.1
V_F (V)
0
1
2
3
4

SILICON DIODES

Silicon alloyed general purpose diodes in a subminiature all glass DO-7 envelope.

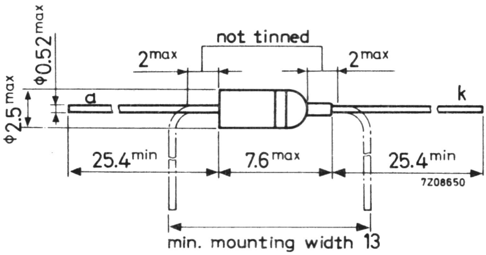
QUICK REFERENCE DATA

			OA200	OA202	
Continuous reverse voltage	V_R	max.	50	150	V
Repetitive peak forward current	I_{FRM}	max.	250		mA
Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	0.4		°C/mW
Forward voltage I_F = 30 mA; T_{amb} = 25 °C	V_F	typ.	0.9		V
Reverse recovery time when switched from I_F = 30 mA to V_R = 35 V; R_L = 2.5 kΩ measured at I_R = 4 mA	t_{rr}	typ.	3.5		µs

MECHANICAL DATA

Dimensions in mm

DO-7


ϕ0.52 max
not tinned
2 max
2 max
ϕ2.5 max
a
k
25.4 min
7.6 max
25.4 min
7Z08650
min. mounting width 13

The coloured band indicates the cathode

RATINGS (Limiting values) [1]

Voltage

Continuous reverse voltage	OA200	V_R	max.	50	V
	OA202	V_R	max.	150	V

Currents

			T_{amb} = 25 °C	T_{amb} = 125 °C	
Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	160	48	mA
Average forward current for sinusoidal operation	I_{FAV}	max.	80	40	mA
Forward current (d.c.; see page 4)	I_F	max.	160	48	mA
Repetitive peak forward current	I_{FRM}	max.	250	125	mA

Temperatures

Storage temperature	T_{stg}	-55 °C to +125	°C
Operating ambient	T_{amb}	max. 125	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\,j\text{-}a}$	=	0.4	°C/mW

CHARACTERISTICS

				T_{amb} = 25 °C	T_{amb} = 125 °C	
Forward voltage						
I_F = 0.1 mA		V_F	typ.	0.52	–	V
			<	0.62	0.30	V
I_F = 10 mA		V_F	typ.	0.80	–	V
			<	0.96	0.65	V
I_F = 30 mA		V_F	typ.	0.90	–	V
			<	1.15	0.80	V
Reverse current						
$V_R = V_{Rmax}$	OA200	I_R	typ.	0.02	1	μA
			<	0.10	10	μA
	OA202	I_R	typ.	0.01	0.5	μA
			<	0.10	10	μA

Diode capacitance

V_R = 0.75 V; f = 0.5 MHz	C_d	typ.	10	pF
		<	25	pF

---

[1] Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

CHARACTERISTICS (continued) T_{amb} = 25 °C

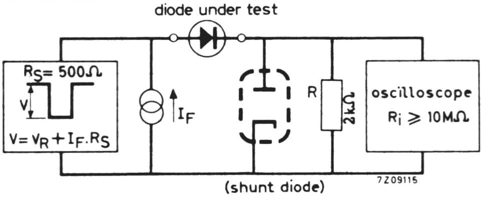
Reverse recovery current when switched from

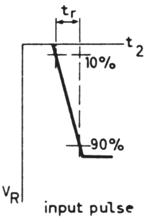
I_F = 5 mA to V_R = 5 V; R_L = 2 .5 kΩ				
measured at t_{rr} = 3.5 μs	I_R	typ.	1.2	mA
t_{rr} = 10 μs	I_R	typ.	35	μA

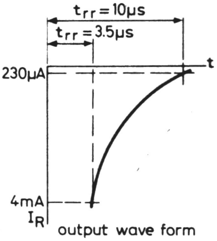
Reverse recovery current when switched from

I_F = 30 mA to V_R = 35 V; R_L = 2.5 kΩ				
measured at t_{rr} = 3.5 μs	I_R	typ.	4	mA
t_{rr} = 10 μs	I_R	typ.	230	μA

Test circuit:

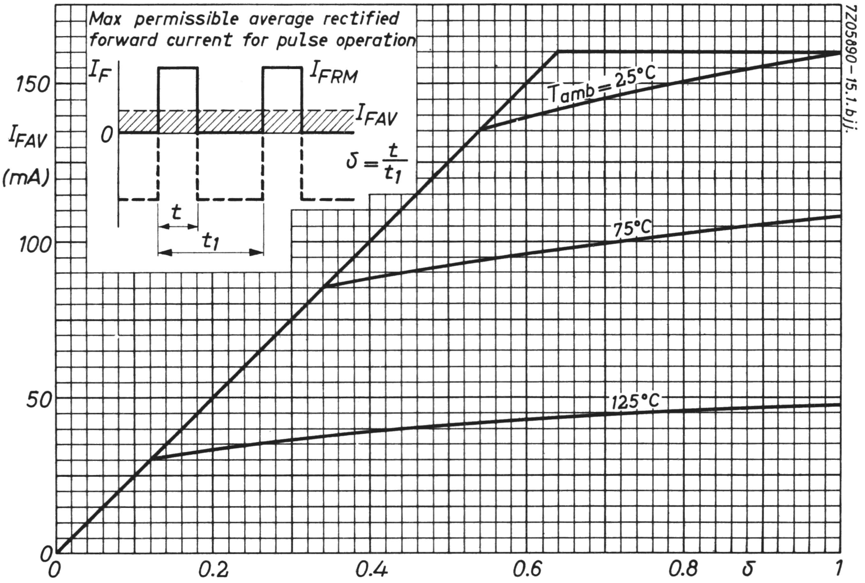

diode under test
R_S= 500Ω
V
V= V_R + I_F.R_S
I_F
R
2kΩ
oscilloscope
R_i ≥ 10MΩ
(shunt diode)
7Z09115

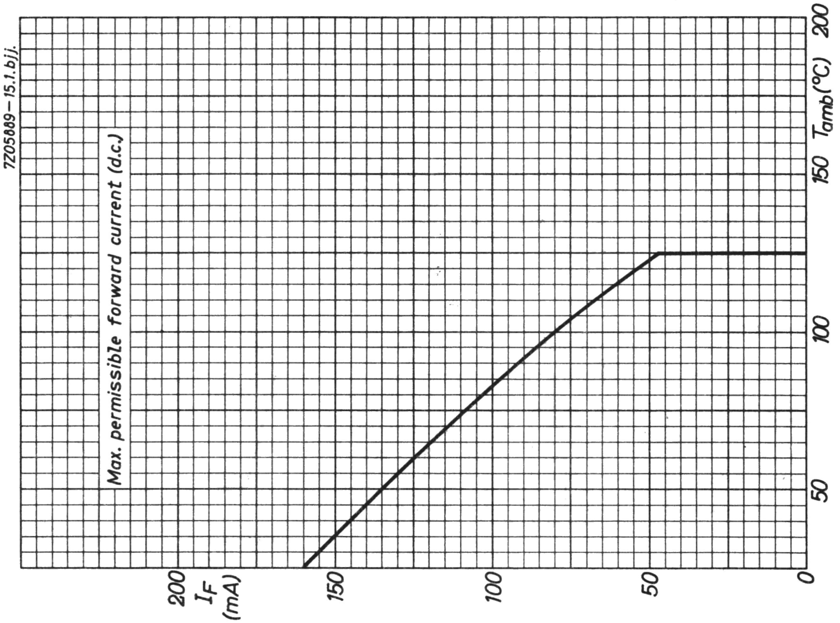

t_r
t
10%
90%
V_R
input pulse

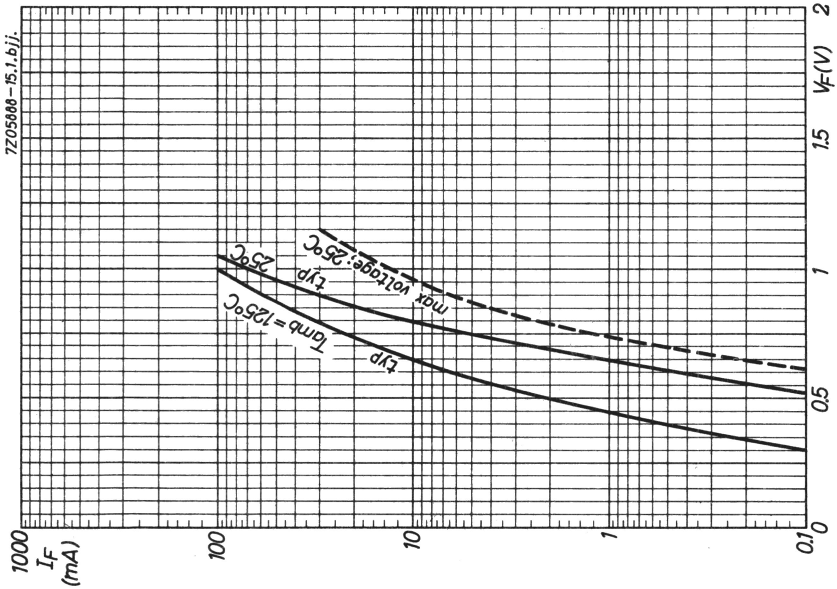

t_{rr} = 10μs
t_{rr} = 3.5μs
t
230μA
4mA
I_R
output wave form

Reverse pulse: Rise time $t_r \leq 0.1$ μs
Duty cycle δ = 0.5
Frequency f = 50 kHz

Oscilloscope: Capacitance C = 40 pF
Rise time t_r = 25 ns




7Z05889-15.1.bjj.
Max. permissible forward current (d.c.)
200
I_F
(mA)
150
100
50
0
50
100
150
200
T_{amb}(°C)


7Z05888-15.1.bjj.
1000
I_F
(mA)
100
10
1
0.1
0
0.5
1
1.5
2
V_F(V)
typ 25°C
T_{amb} = 125°C
typ
max voltage: 25°C

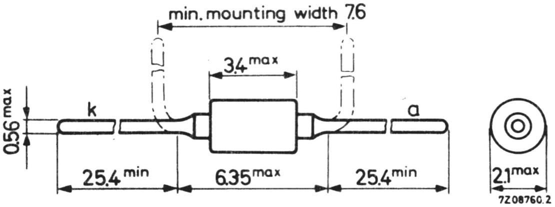
SILICON OXIDE PASSIVATED DIODES

Whiskerless diodes in a hard glass subminiature envelope.
These high speed diodes are primarily intended for fast logic applications.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	75	V
Repetitive peak reverse voltage	V_{RRM}	max.	100	V
Repetitive peak forward current	I_{FRM}	max.	225	mA
Forward voltage				
1N914 : I_F = 10 mA 1N914A: I_F = 20 mA 1N914B: I_F = 100 mA	V_F	<	1	V
Reverse recovery time when switched from I_F = 10 mA to V_R = 6 V;				
R_L = 100 Ω				
measured at I_R = 1 mA	t_{rr}	<	4	ns

MECHANICAL DATA

Dimensions in mm


min. mounting width 7.6
3.4 max
0.56 max
k
a
25.4 min
6.35 max
25.4 min
2.1 max
7Z08760.2

E.I.A. colour code

RATINGS (Limiting values) [1]

Voltages

Continuous reverse voltage		V_R	max.	75	V
Repetitive peak reverse voltage		V_{RRM}	max.	100	V

Currents

Average rectified forward current (averaged over any 20 ms period)	$T_{amb} = 25\,^{o}C$	I_{FAV}	max.	75	mA
	$T_{amb} = 150\,^{o}C$	I_{FAV}	max.	10	mA
Forward current (d.c.)		I_F	max.	75	mA
Repetitive peak forward current		I_{FRM}	max.	225	mA
Non repetitive peak forward current (t = 1 s)		I_{FSM}	max.	500	mA
Total power dissipation		P_{tot}	max.	250	mW

Temperatures

Storage temperature	T_{stg}	−65 to +200	^{o}C
Operating ambient temperature	T_{amb}	−65 to +175	^{o}C

CHARACTERISTICS

$T_j = 25\,^{o}C$ unless otherwise specified

Forward voltages

1N914 : I_F = 10 mA 1N914A: I_F = 20 mA 1N914B: I_F = 100 mA	V_F	<	1	V
1N914B: I_F = 5 mA	V_F		0.62 to 0.72	V

Reverse breakdown voltage

$I_R = 100\ \mu A$	$V_{(BR)R}$	>	100	V

Reverse currents

V_R = 20 V	I_R	<	25	nA
V_R = 75 V	I_R	<	5	μA
V_R = 20 V; $T_j = 150\,^{o}C$	I_R	<	50	μA
1N914B: V_R = 100 V	I_R	<	100	μA

Diode capacitance

V_R = 0; f = 1 MHz	C_d	<	4	pF

---

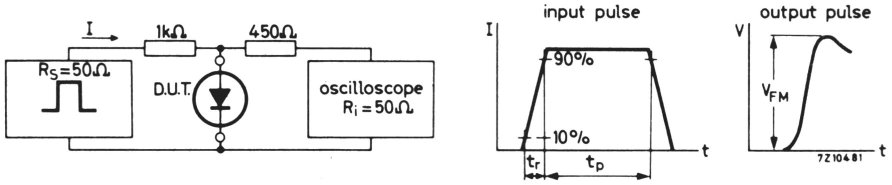
[1] Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

CHARACTERISTICS (continued) $T_j = 25\ ^{o}C$ unless otherwise specified

Forward recovery voltage when switched to

$I_F = 50$ mA; $t_r = 20$ ns $V_{FM} < 2.5$ V

Test circuit:


I
1kΩ
450Ω
R_S=50Ω
D.U.T.
oscilloscope
R_i=50Ω
input pulse
I
90%
10%
t_r
t_p
t
output pulse
V
V_FM
t
7Z10481

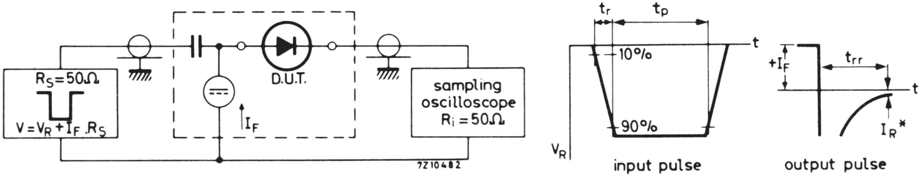
Current pulse:	Rise time	t_r =	20	ns	Oscilloscope:		
	Pulse duration	t_p =	120	ns	Rise time	t_r = 0.35	ns
	Duty cycle	δ =	0.01				

Circuit capacitance C < 1 pF (C = Oscilloscope + parasitical capacitance)

Reverse recovery time when switched from

$I_F = 10$ mA to V_R; $R_L = 100\ \Omega$
measured at $I_R = 1$ mA; switched to $V_R = 1$ V $t_{rr} < 8$ ns
$V_R = 6$ V $t_{rr} < 4$ ns

Test circuit:


R_S=50Ω
V=V_R+I_F.R_S
D.U.T.
I_F
sampling
oscilloscope
R_i=50Ω
7Z10482
t_r
t_p
t
10%
90%
V_R
input pulse
+I_F
t_rr
t
I_R*
output pulse

*) $I_R = 1$ mA

Reverse pulse:	Rise time	t_r =	0.6	ns	Oscilloscope:		
	Pulse duration	t_p =	100	ns	Rise time	t_r = 0.35	ns
	Duty cycle	δ =	0.05				

Circuit capacitance C $\leq$ 1 pF (C = Oscilloscope + parasitical capacitance)

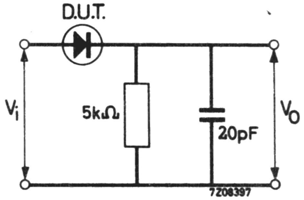
CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

Rectifying efficiency

$$\eta = \frac{V_O}{V_{i(rms)} \sqrt{2}}$$

f = 100 MHz; $V_{i(rms)}$ = 2 V η > 45 %

Test circuit:


D.U.T.
V_i
5kΩ
20pF
V_O
7208397

SILICON OXIDE PASSIVATED DIODES

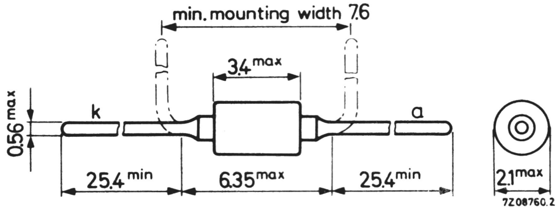
Whiskerless diodes in a hard glass subminiature envelope.
These high speed diodes are primarily intended for fast logic applications.

QUICK REFERENCE DATA

Continuous reverse voltage	V_R	max.	75	V
Repetitive peak reverse voltage	V_{RRM}	max.	100	V
Repetitive peak forward current	I_{FRM}	max.	225	mA
Forward voltage 1N916 : I_F = 10 mA 1N916A: I_F = 20 mA 1N916B: I_F = 30 mA	V_F	<	1	V
Reverse recovery time when switched from I_F = 10 mA to V_R = 6 V; R_L = 100 Ω measured at I_R = 1 mA	t_{rr}	<	4	ns

MECHANICAL DATA

Dimensions in mm


min. mounting width 7.6
3.4 max
0.56 max
k
a
25.4 min
6.35 max
25.4 min
2.1 max
7Z08760.2

E.I.A. colour code

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

Continuous reverse voltage	V_R	max.	75	V
Repetitive peak reverse voltage	V_{RRM}	max.	100	V

Currents

Average rectified forward current (averaged over any 20 ms period) T_{amb} = 25 °C	I_{FAV}	max.	75	mA
T_{amb} = 150 °C	I_{FAV}	max.	10	mA
Forward current (d.c.)	I_F	max.	75	mA
Repetitive peak forward current	I_{FRM}	max.	225	mA
Non repetitive peak forward current (t = 1 s)	I_{FSM}	max.	500	mA
Total power dissipation	P_{tot}	max.	250	mW

Temperatures

Storage temperature	T_{stg}	-65 to +200	°C
Operating ambient temperature	T_{amb}	-65 to +175	°C

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Forward voltages

1N916 : I_F = 10 mA 1N916A: I_F = 20 mA 1N916B: I_F = 30 mA	V_F	<	1	V
1N916B: I_F = 5 mA	V_F		0.63 to 0.73	V

Reverse breakdown voltage

I_R = 100 μA	$V_{(BR)R}$	>	100	V

Reverse currents

V_R = 20 V	I_R	<	25	nA
V_R = 75 V	I_R	<	5	μA
V_R = 20 V; T_j = 150 °C	I_R	<	50	μA

Diode capacitance

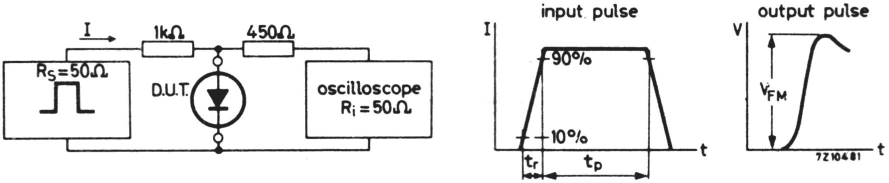
V_R = 0; f = 1 MHz	C_d	<	2	pF

CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

Forward recovery voltage when switched to

I_F = 50 mA; t_r = 20 ns V_{FM} < 2.5 V

Test circuit:


I
1kΩ
450Ω
$R_S = 50\Omega$
D.U.T.
oscilloscope
$R_i = 50\Omega$
input pulse
I
90%
10%
t
t_r
t_p
output pulse
V
V_{FM}
t
7Z10481

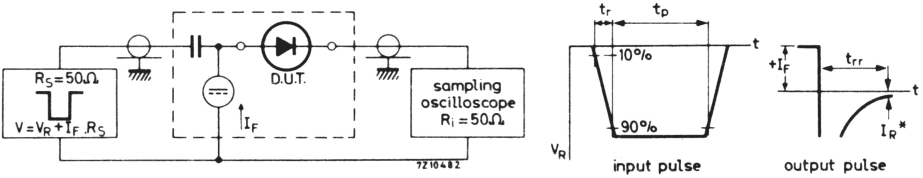
Current pulse:	Rise time	t_r = 20 ns	Oscilloscope:	
	Pulse duration	t_p = 120 ns	Rise time	t_r = 0.35 ns
	Duty cycle	δ = 0.01		

Circuit capacitance $C < 1$ pF (C = Oscilloscope + parasitical capacitance)

Reverse recovery time when switched from

I_F = 10 mA to V_R = 6 V; R_L = 100 Ω
measured at I_R = 1 mA t_{rr} < 4 ns

Test circuit:


$R_S = 50\Omega$
$V = V_R + I_F . R_S$
D.U.T.
I_F
sampling
oscilloscope
$R_i = 50\Omega$
7Z10482
t_r
t_p
t
10%
90%
V_R
input pulse
$+I_F$
t_{rr}
t
I_R*
output pulse

*) I_R = 1 mA

Reverse pulse:	Rise time	t_r = 0.6 ns	Oscilloscope:	
	Pulse duration	t_p = 100 ns	Rise time	t_r = 0.35 ns
	Duty cycle	δ = 0.05		

Circuit capacitance $C \leq 1$ pF (C = Oscilloscope + parasitical capacitance)

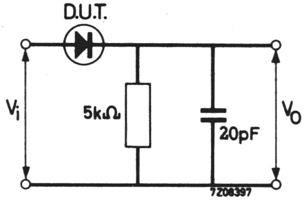
CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

Rectifying efficiency

$$\eta = \frac{V_O}{V_{i(rms)} \sqrt{2}}$$

f = 100 MHz; $V_{i(rms)}$ = 2 V η > 45 %

Test circuit:


D.U.T.
V_i
5kΩ
20pF
V_O
7Z08397

ULTRA HIGH SPEED SILICON DIODE

General purpose diode for military and industrial applications.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltage

Continuous reverse voltage at T_{amb} = 25 °C	V_R	max.	25	V

Power dissipation

Total power dissipation at T_{amb} = 25 °C	P_{tot}	max.	250	mW

Temperature

Storage temperature	T_{stg}	−65 to +200	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.6	°C/mW

CHARACTERISTICS T_{amb} = 25 °C unless otherwise specified

Forward voltage

I_F = 30 mA	V_F	<	1	V

Reverse breakdown voltage

I_R = 5 μA	$V_{(BR)R}$	>	35	V

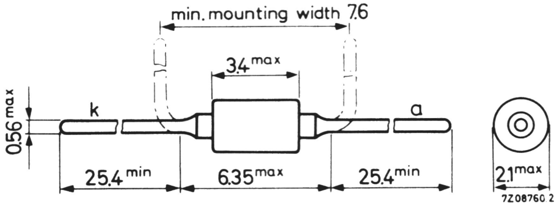
Reverse currents

V_R = 25 V	I_R	<	0.1	μA
V_R = 25 V; T_{amb} = 150 °C	I_R	<	100	μA

Diode capacitance

V_R = 0; f = 1 MHz	C_d	<	4	pF

MECHANICAL DATA Dimensions in mm



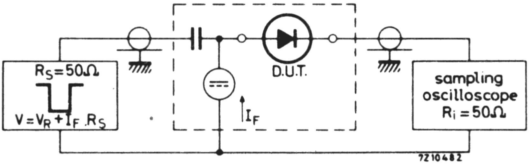
E.I.A. colour code

CHARACTERISTICS (continued) T_{amb} = 25 °C unless otherwise specified

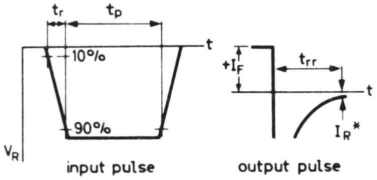
Reverse recovery time when switched from

I_F = 10 mA to V_R; R_L = 100 Ω				
measured at I_R = 1 mA; switched to V_R = 1 V	t_{rr}	<	4	ns
V_R = 6 V	t_{rr}	<	2	ns

Test circuit:



$R_S = 50\Omega$
$V = V_R + I_F.R_S$
D.U.T.
I_F
sampling oscilloscope $R_i = 50\Omega$
7210482



t_r
t_p
t
10%
90%
V_R
input pulse
$+I_F$
t_{rr}
t
I_R*
output pulse

*) I_R = 1 mA

Reverse pulse:					Oscilloscope:				
Rise time	t_r	≤	0.5	ns	Rise time	t_r	≤	0.6	ns

ULTRA HIGH SPEED SILICON DIODES

Whiskerless diodes in a subminiature DO-35 envelope.
These high speed diodes are primarily intended for fast logic applications.

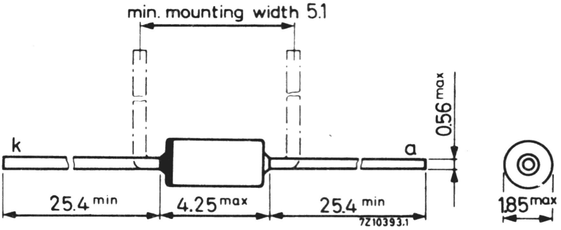
QUICK REFERENCE DATA

Continuous reverse voltage		V_R	max.	75	V
Repetitive peak reverse voltage		V_{RRM}	max.	75	V
Repetitive peak forward current	1N4148	I_{FRM}	max.	225	mA
	1N4446; 1N4448	I_{FRM}	max.	450	mA
Forward voltage	1N4148: I_F = 10 mA 1N4446: I_F = 20 mA 1N4448: I_F = 100 mA	V_F	<	1	V
Reverse recovery time when switched from I_F = 10 mA to V_R = 6 V; R_L = 100 Ω measured at I_R = 1 mA		t_{rr}	<	4	ns

MECHANICAL DATA

Dimensions in mm

DO-35



Cathode indicated by coloured mark or by broad band if colour coded (see General Section)

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

			1N4148	1N4446 1N4448	
Voltages					
Continuous reverse voltage	V_R	max.	75	75	V
Repetitive peak reverse voltage	V_{RRM}	max.	75	75	V
Currents					
Average rectified forward current	I_{FAV}	max.	75	150	mA
Forward current (d.c.)	I_F	max.	75	200	mA
Repetitive peak forward current	I_{FRM}	max.	225	450	mA
Non repetitive peak forward current t = 1 μs	I_{FSM}	max.	2000	2000	mA
t = 1 s	I_{FSM}	max.	500	500	mA
Total power dissipation up to $T_{amb} = 25\,^oC$	P_{tot}	max.	500		mW
Derating factor			2.85		mW/°C
Temperatures					
Storage temperature	T_{stg}		−65 to +200		°C
Junction temperature	T_j	max.	200		°C

CHARACTERISTICS $T_j = 25\,^oC$ unless otherwise specified

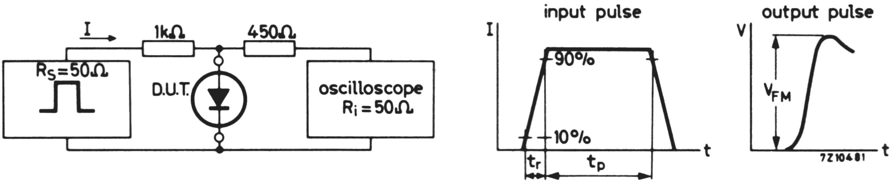
Forward voltages				
1N4148: $I_F = 10$ mA 1N4446: $I_F = 20$ mA 1N4448: $I_F = 100$ mA	V_F	<	1	V
1N4448: $I_F = 5$ mA	V_F		0.62 to 0.72	V
Reverse breakdown voltage				
$I_R = 100\ \mu A$	$V_{(BR)R}$	>	100	V
$I_R = 5\ \mu A$	$V_{(BR)R}$	>	75	V
Reverse currents				
$V_R = 20$ V	I_R	<	25	nA
$V_R = 20$ V; $T_j = 100\,^oC$ 1N4448	I_R	<	3	μA
$V_R = 20$ V; $T_j = 150\,^oC$	I_R	<	50	μA
Diode capacitance				
$V_R = 0$; f = 1 MHz	C_d	<	4	pF

CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

Forward recovery voltage when switched to

I_F = 50 mA; t_r = 20 ns 1N4448 V_{FM} < 2.5 V

Test circuit:


I
1kΩ
450Ω
R_S=50Ω
D.U.T.
oscilloscope
R_i=50Ω
input pulse
I
90%
10%
t
t_r
t_p
output pulse
V
V_{FM}
t
7Z10481

Current pulse: Rise time t_r = 20 ns

Pulse duration t_p = 120 ns

Duty cycle δ = 0.01

Oscilloscope:

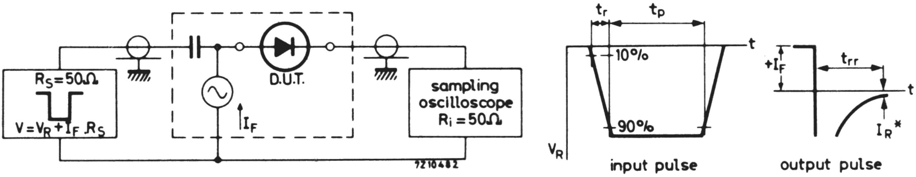
Rise time t_r = 0.35 ns

Circuit capacitance $C < 1$ pF (C = Oscilloscope + parasitical capacitance)

Reverse recovery time when switched from

I_F = 10 mA to V_R = 6 V; R_L = 100 Ω
measured at I_R = 1 mA t_{rr} < 4 ns

Test circuit:


R_S=50Ω
$V=V_R+I_F.R_S$
D.U.T.
I_F
sampling oscilloscope
R_i=50Ω
7Z10482
t_r
t_p
t
10%
90%
V_R
input pulse
$+I_F$
t_{rr}
t
I_R*
output pulse

*) I_R = 1 mA

Reverse pulse: Rise time t_r = 0.6 ns

Pulse duration t_p = 100 μs

Duty cycle δ = 0.05

Oscilloscope:

Rise time t_r = 0.35 ns

Circuit capacitance $C \leq 1$ pF (C = Oscilloscope + parasitical capacitance)

ULTRA HIGH SPEED SILICON DIODES

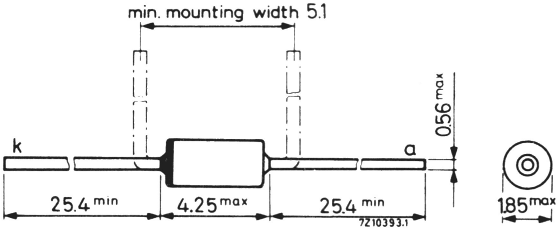
Whiskerless diodes in a subminiature DO-35 envelope.
The 1N4150 is primarily intended for general purpose use in computer and industrial applications. The 1N4151 and 1N4154 are intended for military and industrial applications.

QUICK REFERENCE DATA

			1N4150	1N4151	1N4154	
Continuous reverse voltage	V_R	max.	50	50	25	V
Repetitive peak reverse voltage	V_{RRM}	max.	–	75	–	V
Repetitive peak forward current	I_{FRM}	max.	0.60	0.45	0.45	A
Non repetitive peak forward current						
$t = 1\ \mu s$	I_{FSM}	max.	4	–	–	A
$t = 1$ s	I_{FSM}	max.	0.5	–	–	A
Forward voltage						
I_F = 30 mA	V_F	<	–	–	1	V
I_F = 50 mA	V_F	<	–	1	–	V
I_F = 200 mA	V_F	<	1	–	–	V
Reverse recovery time when switched from: I_F = 400 mA to I_R = 400 mA measured at I_R = 40 mA	t_{rr}	<	6	–	–	ns
I_F = 10 mA to I_R = 10 mA measured at I_R = 1 mA	t_{rr}	<	–	4	4	ns

MECHANICAL DATA Dimensions in mm

DO-35



Cathode indicated by coloured mark or by broad band if colour coded (see General Section)

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages			1N4150	1N4151	1N4154	
Continuous reverse voltage	V_R	max.	50	50	25	V
Repetitive peak reverse voltage	V_{RRM}	max.	–	75	–	V
Currents						
Forward current (d.c.)	I_F	max.	0.3	0.2	0.2	A
Repetitive peak forward current	I_{FRM}	max.	0.60	0.45	0.45	A
Non repetitive peak forward current t = 1 μs	I_{FSM}	max.	4	–	–	A
t = 1 s	I_{FSM}	max.	0.5	–	–	A

Total power dissipation				
up to T_{amb} = 25 °C	P_{tot}	max.	500	mW
Derating factor			2.85	mW/°C
Temperatures				
Storage temperature	T_{stg}		−65 to +200	°C
Junction temperature	T_j	max.	200	°C

CHARACTERISTICS

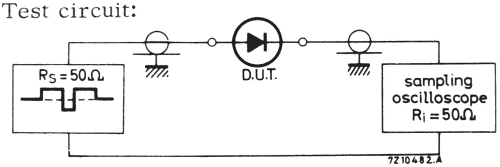
T_{amb} = 25 °C unless otherwise specified

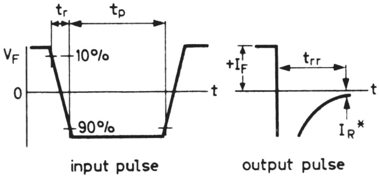
Forward voltages			1N4150	1N4151	1N4154	
I_F = 1 mA	V_F	>	0.54	–	–	V
		<	0.62	–	–	V
I_F = 10 mA	V_F	>	0.66	–	–	V
		<	0.74	–	–	V
I_F = 30 mA	V_F	<	–	–	1	V
I_F = 50 mA	V_F	>	0.76	–	–	V
		<	0.86	1	–	V
I_F = 100 mA	V_F	>	0.82	–	–	V
		<	0.92	–	–	V
I_F = 200 mA	V_F	>	0.87	–	–	V
		<	1	–	–	V
Reverse breakdown voltage						
I_R = 5 μA	$V_{(BR)R}$	>	–	75	35	V
Reverse currents						
V_R = 25 V	I_R	<	–	–	0.1	μA
V_R = 25 V; T_{amb} = 150 °C	I_R	<	–	–	100	μA
V_R = 50 V	I_R	<	0.1	0.05	–	μA
V_R = 50 V; T_{amb} = 150 °C	I_R	<	100	50	–	μA

CHARACTERISTICS (continued)

			1N4150	1N4151	1N4154	
Diode capacitance						
$V_R = 0$; f = 1 MHz	C_d	<	2.5	2	4	pF
Reverse recovery time when switched from:						
I_F = 10 to 100 mA to I_R = 10 to 100 mA measured at $I_R = 0.1 \times I_F$	t_{rr}	<	4	–	–	ns
I_F = 200 to 400 mA to I_R = 200 to 400 mA measured at $I_R = 0.1 \times I_F$	t_{rr}	<	6	–	–	ns
I_F = 10 mA to I_R = 1 mA measured at I_R = 0.1 mA	t_{rr}	<	6	–	–	ns
I_F = 10 mA to I_R = 10 mA measured at I_R = 1 mA	t_{rr}	<	–	4	4	ns
I_F = 10 mA to V_R = 6 V; R_L = 100 Ω measured at I_R = 1 mA	t_{rr}	<	–	2	2	ns

Test circuit:





input pulse output pulse

* value at which t_{rr} is measured

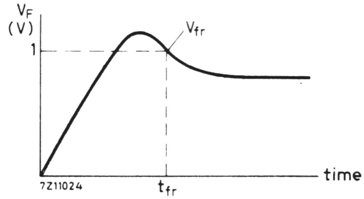
Reverse pulse: Rise time t_r = 0.5 ns
Pulse duration t_p = 100 μs
Duty cycle δ = 0.05

Oscilloscope:
Rise time t_r = 0.6 ns

Circuit capacitance $C \leq 1$ pF (C = Oscilloscope + parasitical capacitance)

Forward recovery time when switched from

$I = 0$ to I_F = 200 mA
t_r = 0.4 ns; t_p = 100 ns
$\delta < 0.01$; measured at V_{fr} = 1 V — 1N4150 — t_{fr} < 10 ns



Variable capacitance diodes

VOLTAGE DEPENDENT CAPACITOR

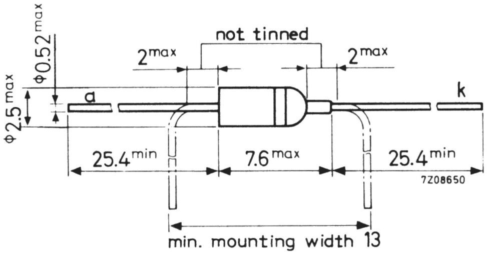
Silicon voltage dependent capacitor in subminiature all-glass DO-7 construction intended for automatic frequency control in television receivers.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	20	V
Reverse current (d.c.)	I_R	max.	100	μA
Junction temperature	T_j	max.	90	$^{\circ}$C
Capacitance ratio	$\frac{C_d\ (V_R = 10\ V)}{C_d\ (V_R = 4\ V)}$	<	0.7	

MECHANICAL DATA

Dimensions in mm

DO-7



ϕ0.52 max
ϕ2.5 max
not tinned
2 max
2 max
a
k
25.4 min
7.6 max
25.4 min
7Z08650
min. mounting width 13

The coloured band indicates the cathode

RATINGS (Limiting values) [1]

Continuous reverse voltage	V_R	max.	20	V
Reverse current (d.c.)	I_R	max.	100	μA
Junction temperature	T_j	max.	90	$^{\circ}$C
Storage temperature	T_{stg}		-55 to +90	$^{\circ}$C

THERMAL RESISTANCE

From junction to ambient in free air $R_{th\ j-a}$ = 0.4 $^{\circ}$C/mW

---

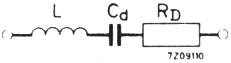
[1] Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

CHARACTERISTICS

$T_j = 25\ ^\circ C$ unless otherwise specified

Reverse current at $T_j = 80\ ^\circ C$ $V_R = 20$ V	I_R	<	5	μA
Diode capacitance $V_R = 4$ V; f = 0.5 MHz	C_d		20 to 45	pF 1)
Capacitance ratio at f ≤ 300 MHz	$\frac{C_d\ (V_R = 10\ V)}{C_d\ (V_R = 4\ V)}$	<	0.7	
Series resistance at $V_R = 4$ V	r_D	typ. <	1.7 3	Ω Ω

Simplified equivalent circuit



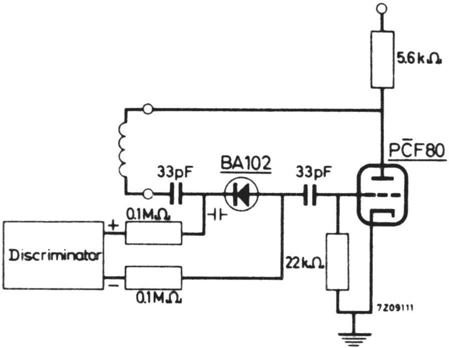
L = lead inductance ≈ 6 nH
r_D = series resistance
C_d = diode capacitance (see page 3)

} frequency independent up to f = 300 MHz

These data apply at a distance between the two measuring points of 10 mm.

APPLICATION INFORMATION

Basic circuit for automatic frequency control in television receivers using the BA102 in series with the oscillator coil.

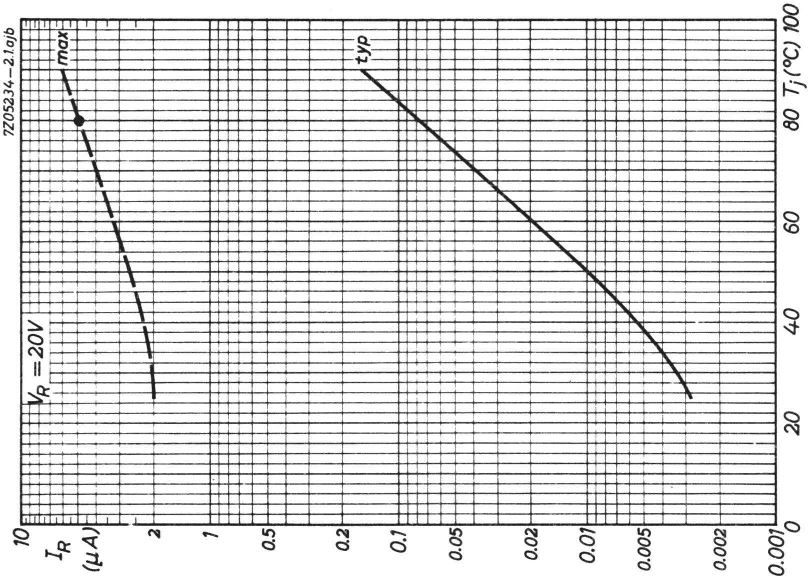


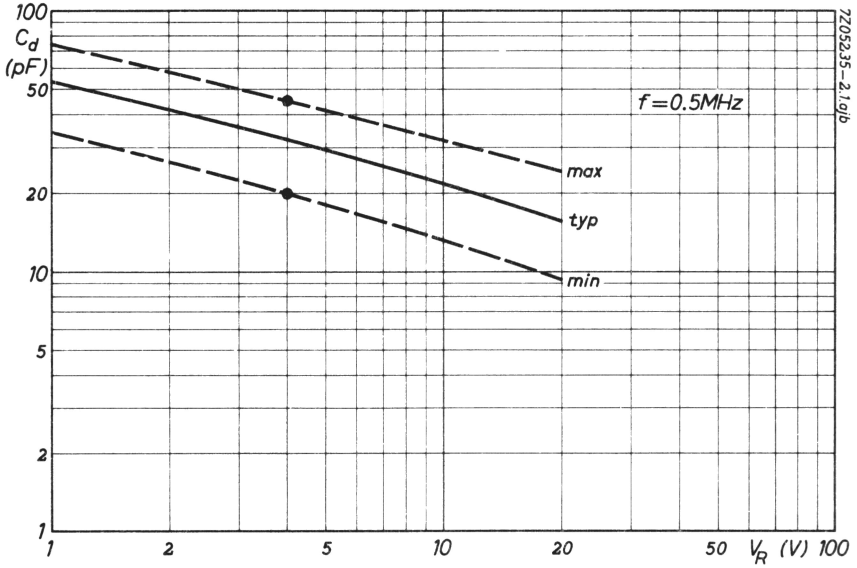
Sensitivity of the discriminator : 25 V/MHz
Reduction of the frequency deviation Band I : 1:10
Band III : 1:25

---

1) For convenience reasons only the spread in the magnitude of C_d is indicated in more detail by means of coloured dots.
At $V_R = 4$ V; f = 0.5 MHz; $T_j = 25\ ^\circ C$

white dot	: C_d	20 to 24	pF
yellow dot	: C_d	24 to 30	pF
blue dot	: C_d	30 to 37	pF
green dot	: C_d	37 to 45	pF


7Z05234−2.1ajb
max
typ
V_R = 20V
I_R (µA)
10
2
1
0.5
0.2
0.1
0.05
0.02
0.01
0.005
0.002
0.001
T_j (°C)
100
80
60
40
20
0


100
C_d (pF)
50
20
10
5
2
1
1
2
5
10
20
50
V_R (V)
100
f = 0.5MHz
max
typ
min
7Z05235−2.1ajb

SILICON PLANAR VARIABLE CAPACITANCE DOUBLE DIODE

The BB104 is a variable capacitance double diode with common cathode in a plastic envelope. The device is primarily intended for electronic tuning in band II (f.m.). It is recommended for stages where large signals occur (e.g. oscillator circuits).

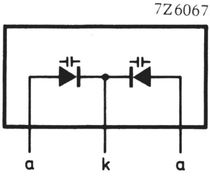
QUICK REFERENCE DATA

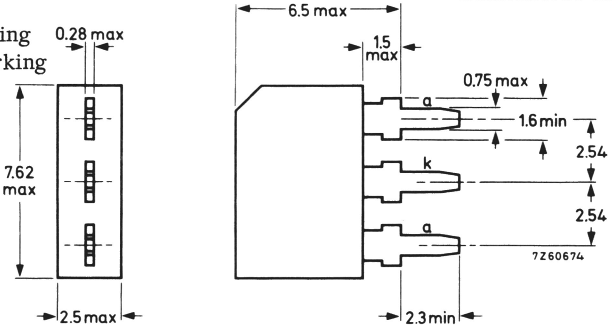
FOR EACH DIODE				
Continuous reverse voltage	V_R	max.	30	V
Junction temperature	T_j	max.	100	°C
Reverse current at V_R = 30 V	I_R	<	20	nA
Diode capacitance at f = 1 MHz		BB104G	BB104B	
V_R = 3 V	C_d	34-39	37-42	pF
Capcitance ratio	$\frac{C_d\ (V_R = 3\ V)}{C_d\ (V_R = 30\ V)}$	typ.	2.65	
Series resistance at f = 100 MHz				
V_R is that value at which C_d = 38 pF	r_D	typ. <	0.3 0.4	Ω Ω

MECHANICAL DATA

Dimensions in mm

BB104B: blue type marking
BB104G: green type marking





The sealing of the plastic envelope withstands the accelerated damp heat test of IEC recommendation 68-2 (test D, severity IV, 6 cycles)

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

FOR EACH DIODE

Voltage				
Continuous reverse voltage	V_R	max.	30	V
Current				
Forward current (d.c.)	I_F	max.	100	mA
Temperatures				
Junction temperature	T_j	max.	100	°C
Storage temperature	T_{stg}	-55 to +100		°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.6	°C/mW

CHARACTERISTICS

Reverse current at $V_R = 30$ V	I_R	typ. <	1 20		nA nA
$V_R = 30$ V; $T_j = 60$ °C	I_R	typ. <	5 200		nA nA
Diode capacitance at f = 1 MHz		BB104G	BB104B		
$V_R = 3$ V	C_d	34-39	37-42		pF
$V_R = 30$ V	C_d	typ.	14		pF
Capacitance ratio at f = 1 MHz	$\frac{C_d\ (V_R = 3\ V)}{C_d\ (V_R = 30\ V)}$	typ.	2.65		
Series resistance at f = 100 MHz					
V_R is that value at which $C_d = 38$ pF	r_D	typ. <	0.3 0.4		Ω Ω
Temperature coefficient of the diode capacitance $V_R = 3$ V	η	typ.	0.04		%/°C

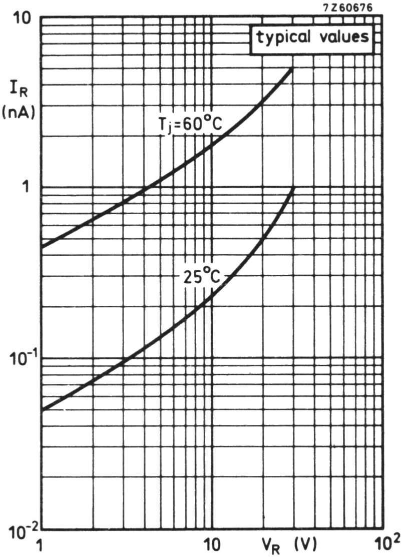
MOUNTING AND SOLDERING INSTRUCTIONS

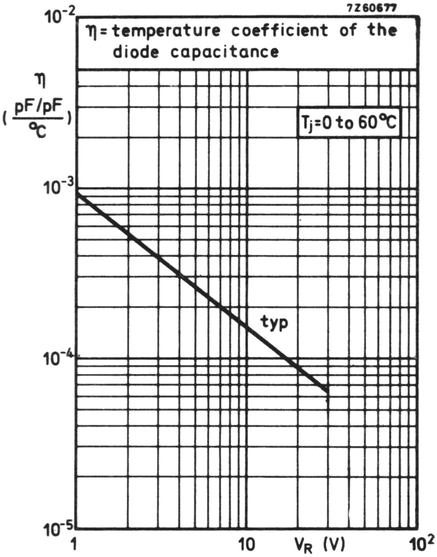
Mounting

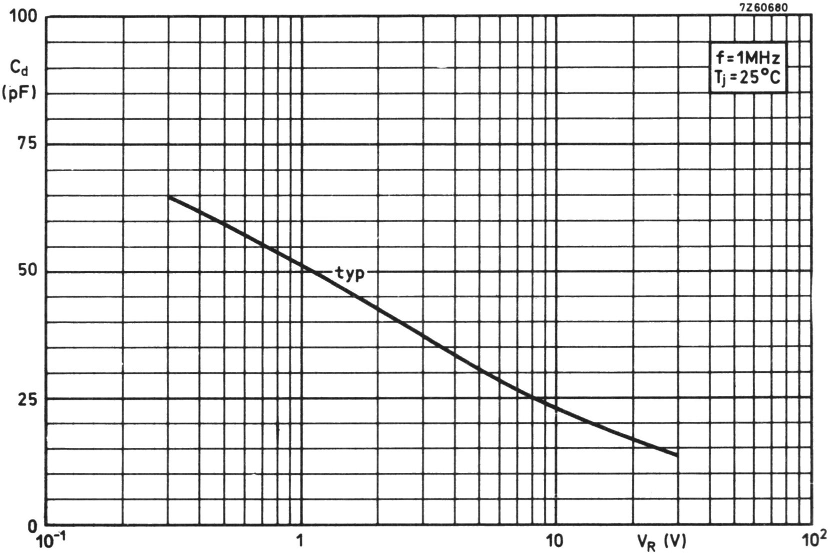
The leads must not be bent with a radius of less than 0.5 mm near the seal. (This can be done by hand if care is taken to exert no pulling force).

Soldering

At a maxium iron or solder temperature of 300 °C, the maximum permissible soldering time is 3 seconds. The soldering spot may be at any distance from the seal. During soldering, care must be taken that the plastic body does not come into contact with any temperature higher than 125 °C.


7Z60676
typical values
I_R (nA)
10
1
10^{-1}
10^{-2}
T_j=60°C
25°C
1
10
V_R (V)
10^2


7Z60677
η = temperature coefficient of the diode capacitance
η (pF/pF / °C)
10^{-2}
10^{-3}
10^{-4}
10^{-5}
T_j=0 to 60°C
typ
1
10
V_R (V)
10^2


7Z60680
C_d (pF)
100
75
50
25
0
f = 1MHz
T_j = 25°C
typ
10^{-1}
1
10
V_R (V)
10^2

SILICON PLANAR VARIABLE CAPACITANCE DIODES

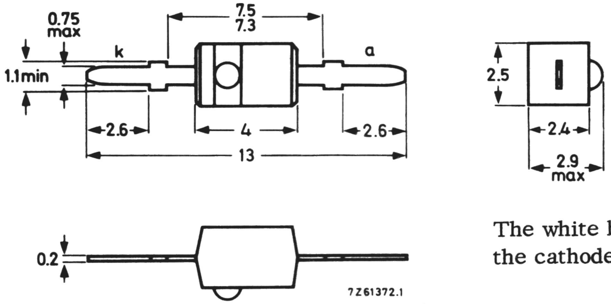
The BB105A is intended for use in u.h.f. tuners up to frequencies of 790 MHz.
The BB105B is meant for u.h.f. tuners up to frequencies of 860 MHz.
The BB105G is meant for v.h.f. tuners.
Twelve matched diodes are delivered together, thus containing 4 triplets or 3 quadruplets.
The capacitance difference between any two of the twelve diodes is less than 3% for the BB105A and BB105B and less than 6% for the BB105G over the voltage range from 0.5 to 28 V.

QUICK REFERENCE DATA

Reverse voltage	V_R	max.	28			V
Reverse current at V_R = 28 V	I_R	<	100			nA
			BB105A	BB105B	BB105G	
Diode capacitance at f = 1 MHz V_R = 25 V	C_d	>	2.3	2.0	1.8	pF
		<	2.8	2.3	2.8	pF
Capacitance ratio at f = 1 MHz	$\frac{C_d(V_R = 3\ V)}{C_d(V_R = 25\ V)}$	>	4	4.5	4	
		<	5	6	6	
Series resistance at f = 470 MHz V_R is that value at which C_d = 9 pF	r_D	typ.	0.6	0.6	0.9	Ω
		<	0.7	0.7	1.2	Ω

MECHANICAL DATA Dimensions in mm

12-BB105A and B: marked on packing
12-BB105G : green dot on the envelope



The white band indicates the cathode side

The sealing of the plastic envelope withstands the accelerated damp heat test of IEC recommendation 68-2 (test D, severity IV, 6 cycles).

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Continuous reverse voltage	V_R	max.	28	V
Reverse voltage (peak value)	V_{RM}	max.	30	V
Forward current (d.c.)	I_F	max.	20	mA
Storage temperature	T_{stg}		−55 to +100	°C
Junction temperature	T_j	max.	60	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.4	°C/mW

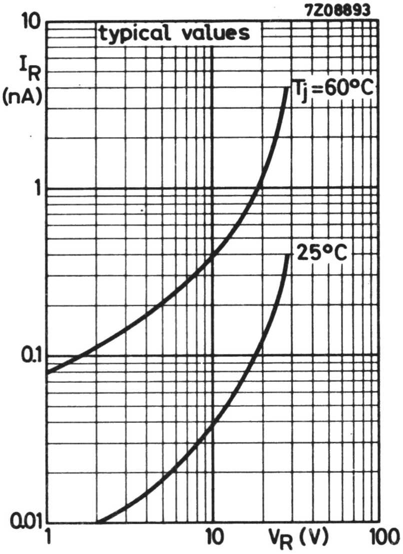
CHARACTERISTICS

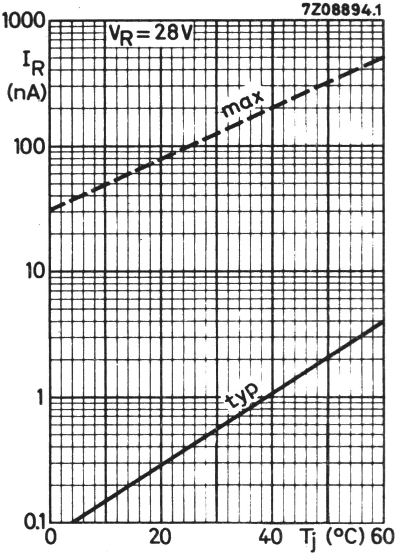
T_j = 25 °C unless otherwise specified

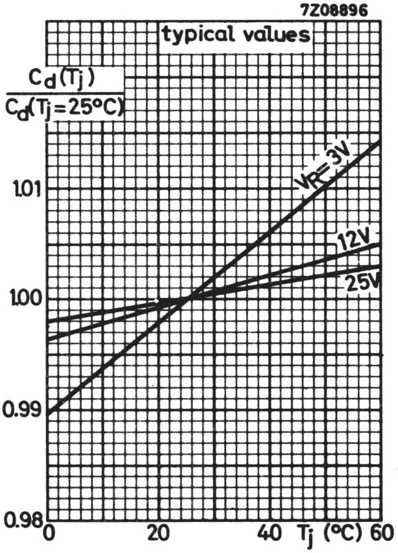
			BB105A	BB105B	BB105G	
Reverse current						
V_R = 28 V	I_R	<	100	100	100	nA
V_R = 28 V; T_j = 60 °C	I_R	<	0.5	0.5	0.5	μA
Diode capacitance at f = 1 MHz						
V_R = 1 V	C_d	typ.	17	17.5	17.5	pF
V_R = 3 V	C_d	typ.	11.5	11.5	11.5	pF
V_R = 25 V	C_d	>	2.3	2.0	1.8	pF
		<	2.8	2.3	2.8	pF
Capacitance ratio at f = 1 MHz	$\frac{C_d(V_R = 3\ V)}{C_d(V_R = 25\ V)}$	>	4	4.5	4	
		<	5	6	6	
Series resistance						
at f = 470 MHz and at that value of V_R at which C_d = 9 pF	r_D	typ.	0.6	0.6	0.9	Ω
		<	0.7	0.7	1.2	Ω
at f = 200 MHz and I_F = 5 mA	r_D	typ.	0.4	0.4	0.4	Ω

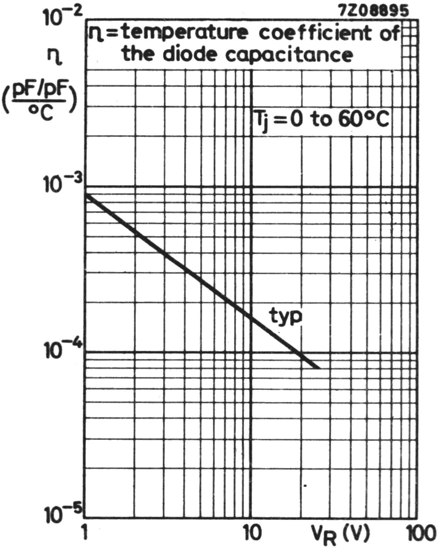
SOLDERING AND MOUNTING NOTES

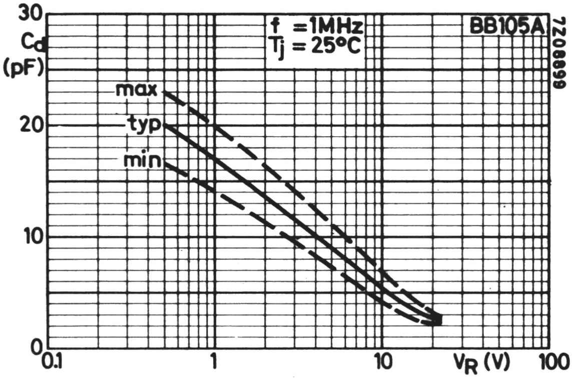
1. Soldered joints may be at any distance from the seal.
2. The maximum permissible temperature of the soldering iron or bath is 300 °C; it must be in contact with the joint for no more than 3 seconds.
3. Avoid hot spots due to handling or mounting; the body of the device must not come into contact with or be exposed to a temperature higher than 125 °C.
4. Leads should not be bent less than 0.5 mm from the seal; exert no axial pull when bending.

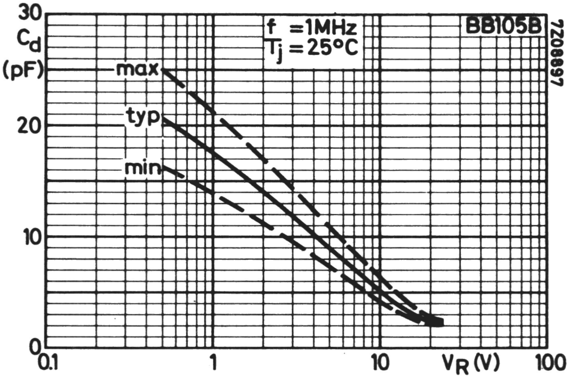

7Z08893
typical values
I_R (nA)
10
1
0.1
0.01
$T_j = 60°C$
25°C
1
10
V_R (V)
100

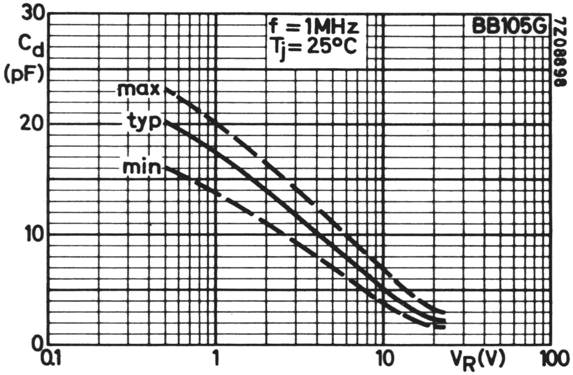

7Z08894.1
$V_R = 28V$
I_R (nA)
1000
100
10
1
0.1
max
typ
0
20
40
T_j (°C)
60


7Z08896
typical values
$\frac{C_d(T_j)}{C_d(T_j = 25°C)}$
1.01
1.00
0.99
0.98
$V_R = 3V$
12V
25V
0
20
40
T_j (°C)
60


7Z08895
η = temperature coefficient of the diode capacitance
η
$\left(\frac{pF/pF}{°C}\right)$
10^{-2}
10^{-3}
10^{-4}
10^{-5}
$T_j = 0$ to $60°C$
typ
1
10
V_R (V)
100


30
Cd
(pF)
20
10
0
0.1
1
10
VR (V)
100
f = 1MHz
Tj = 25°C
BB105A
max
typ
min
7208899


30
Cd
(pF)
20
10
0
0.1
1
10
VR (V)
100
f = 1MHz
Tj = 25°C
BB105B
max
typ
min
7208897

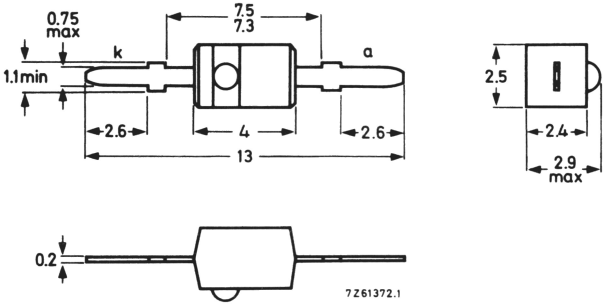

30
Cd
(pF)
20
10
0
0.1
1
10
VR (V)
100
f = 1MHz
Tj = 25°C
BB105G
max
typ
min
7208898

SILICON PLANAR VARIABLE CAPACITANCE DIODE

The 12-BB106 is a variable capacitance diode in a plastic envelope. The diode is primarily intended for electronic tuning in v.h.f. tuners with extended Band I (FCC norm). Twelve matched diodes are delivered together, thus containing 4 triplets or 3 quadruples. The matching is done at different voltages from 0.5 V to 28 V. In this range the capacitance difference between any two diodes of one group is less than 3%.

QUICK REFERENCE DATA				
Diode capacitance at f = 0.5 MHz				
V_R = 3 V	C_d	>	20	pF
V_R = 25 V	C_d		4 to 5.6	pF
Capacitance ratio at f = 0.5 MHz	$\frac{C_d(V_R = 3\ V)}{C_d(V_R = 25\ V)}$		4.5 to 6.0	
Series resistance at f = 200 MHz V_R = that value at which C_d = 25 pF	r_D	typ. <	0.4 0.6	Ω Ω

MECHANICAL DATA Dimensions in mm



The red band indicates the cathode

The sealing of the plastic envelope withstands the accelerated damp heat test of IEC recommendation 68-2 (test D, severity IV, 6 cycles).

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages

Continuous reverse voltage	V_R	max.	28	V
Reverse voltage (peak value)	V_{RM}	max.	30	V

Current

Forward current (d. c.)	I_F	max.	20	mA

Temperatures

Storage temperature	T_{stg}	−55 to +100		°C
Junction temperature	T_j	max.	60	°C

THERMAL RESISTANCE

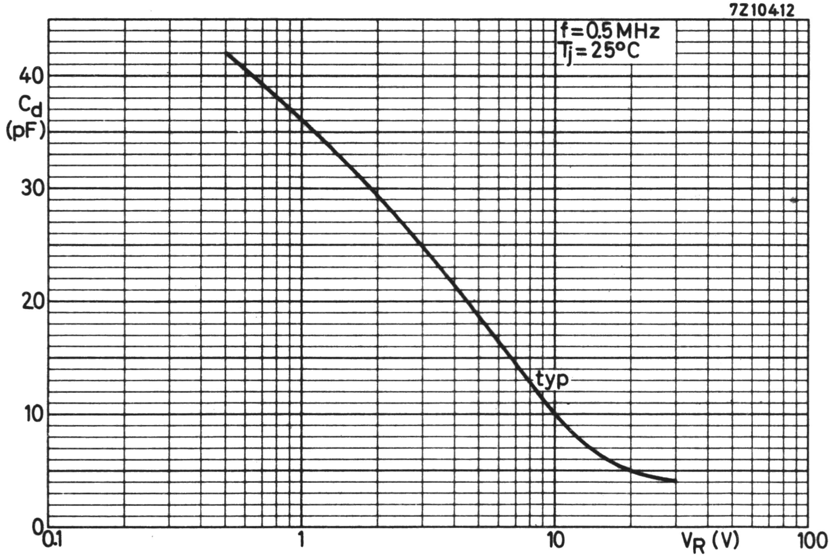
From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	400	°C/W

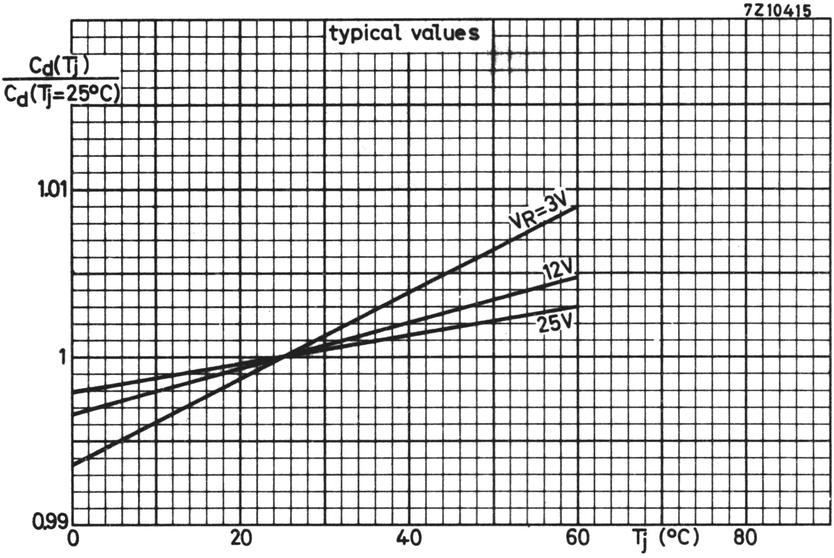
CHARACTERISTICS

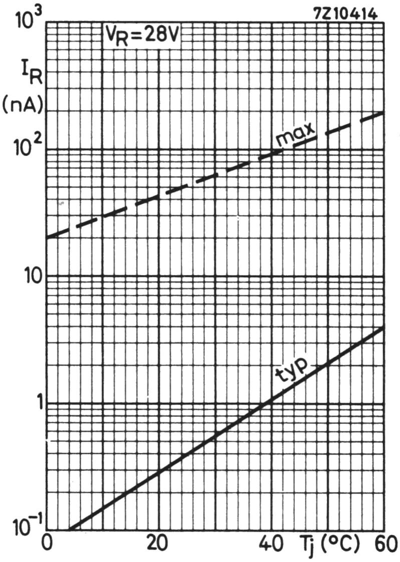
Reverse current at V_R = 28 V; T_j = 25 °C	I_R	<	50	nA
V_R = 28 V; T_j = 60 °C	I_R	<	200	nA
Series resistance at f = 200 MHz				
V_R = that value at which C_d = 25 pF	r_D	typ. <	0.4 0.6	Ω Ω
Diode capacitance at f = 0.5 MHz				
V_R = 3 V	C_d	>	20	pF
V_R = 25 V	C_d	4 to 5.6		pF
Capacitance ratio at f = 0.5 MHz	$\frac{C_d(V_R = 3\text{ V})}{C_d(V_R = 25\text{ V})}$	4.5 to 6.0		

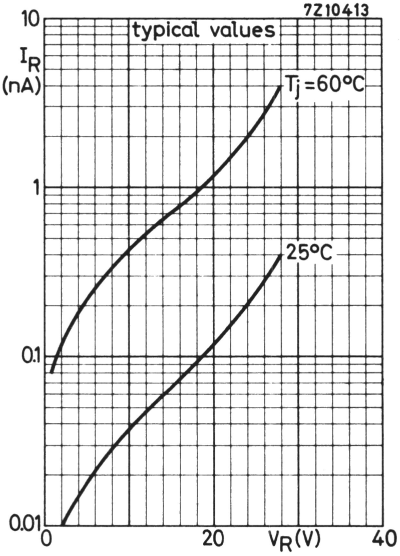
SOLDERING AND MOUNTING NOTES

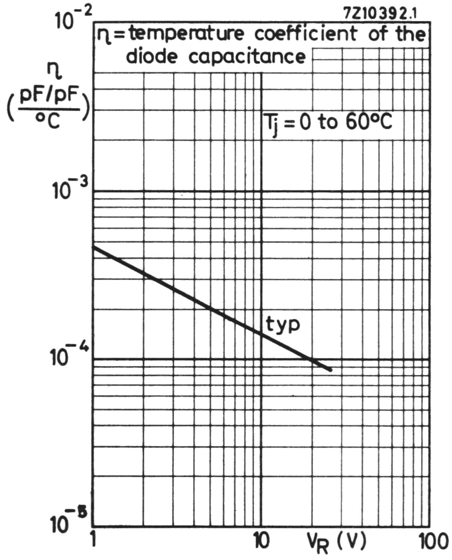
1. Soldered joints may be at any distance from the seal.
2. The maximum permissible temperature of the soldering iron or bath is 300 °C; it must be in contact with the joint for no more than 3 seconds.
3. Avoid hot spots due to handling or mounting; the body of the device must not come into contact with or be exposed to a temperature higher than 125 °C.
4. Leads should not be bent less than 0.5 mm from the seal; exert no axial pull when bending.


7Z10412
f=0.5 MHz
Tj=25°C
Cd
(pF)
40
30
20
10
0
0.1
1
10
VR (V)
100
typ


7Z10415
typical values
Cd(Tj)
Cd(Tj=25°C)
1.01
1
0.99
0
20
40
60
Tj (°C)
80
VR=3V
12V
25V


7Z10414
$V_R = 28V$
I_R (nA)
10^3
10^2
10
1
10^{-1}
max
typ
0
20
40
60
T_j (°C)


7Z10413
typical values
I_R (nA)
10
1
0.1
0.01
$T_j = 60°C$
25°C
0
20
40
V_R (V)


7Z10392.1
η = temperature coefficient of the diode capacitance
η (pF/pF / °C)
10^{-2}
10^{-3}
10^{-4}
10^{-5}
T_j = 0 to 60°C
typ
1
10
100
V_R (V)

SILICON PLANAR VARIABLE CAPACITANCE DIODE

The BB110 is a variable capacitance diode in a plastic envelope. The diode is primarily intended for electronic tuning in band II (f.m.). It is recommended for r.f. and interstage circuits.

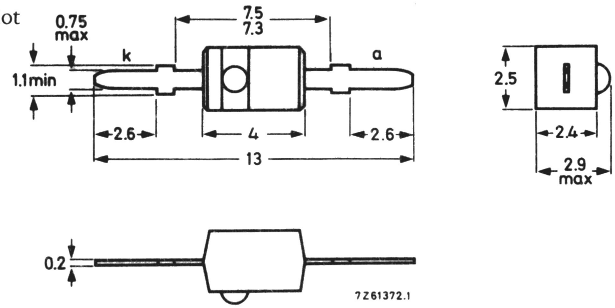
QUICK REFERENCE DATA

Continuous reverse voltage	V_R	max.	30		V
Junction temperature	T_j	max.	100		°C
Reverse current at V_R = 30 V	I_R	<	20		nA
Diode capacitance at f = 1 MHz			BB110G	BB110B	
V_R = 3 V	C_d		27 - 31	29 - 33	pF
Capacitance ratio	$\frac{C_d (V_R = 3\ \text{V})}{C_d (V_R = 30\ \text{V})}$	typ.	2.65		
Series resistance at f = 100 MHz V_R is that value at which C_d = 30 pF	r_D	typ. <	0.3 0.4		Ω Ω

MECHANICAL DATA

Dimensions in mm

BB110B: blue dot
BB110G: green dot



The yellow band indicates the cathode side

The sealing of the plastic envelope withstands the accelerated damp heat test of IEC recommendation 68-2 (test D, severity IV, 6 cycles).

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltage				
Continuous reverse voltage	V_R	max.	30	V
Current				
Forward current (d.c.)	I_F	max.	100	mA
Temperatures				
Storage temperature	T_{stg}		−55 to +100	^oC
Junction temperature	T_j	max.	100	^oC

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.4	$^oC/mW$

CHARACTERISTICS T_j = 25 ^oC unless otherwise specified

Reverse current at V_R = 30 V	I_R	typ. <	1 20	nA nA
V_R = 30 V; T_j = 60 ^oC	I_R	typ. <	5 200	nA nA
Diode capacitance at f = 1 MHz		BB110G	BB110B	
V_R = 3 V	C_d	27 - 31	29 - 33	pF
V_R = 30 V	C_d	typ.	11	pF
→ Capacitance ratio at f = 1 MHz	$\frac{C_d (V_R = 3\ V)}{C_d (V_R = 30\ V)}$	typ.	2.65	
Series resistance at f = 100 MHz				
V_R is that value at which C_d = 30 pF	r_D	typ. <	0.3 0.4	Ω Ω
Temperature coefficient of the diode capacitance				
V_R = 30 V	η	typ.	0.04	%/^oC

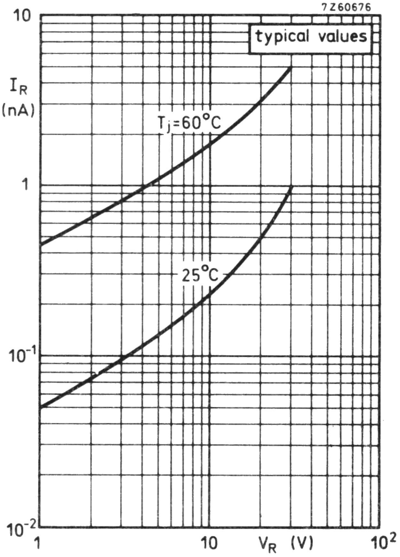
MOUNTING AND SOLDERING INSTRUCTIONS

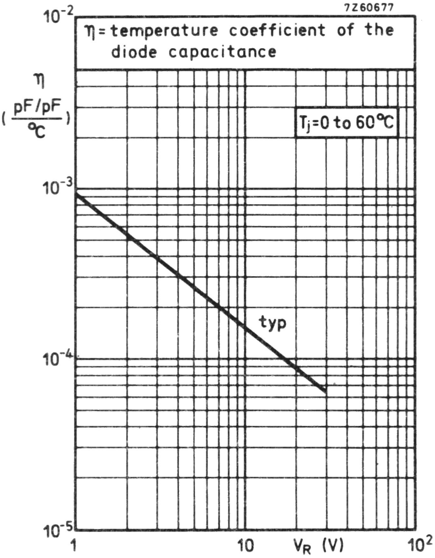
Mounting

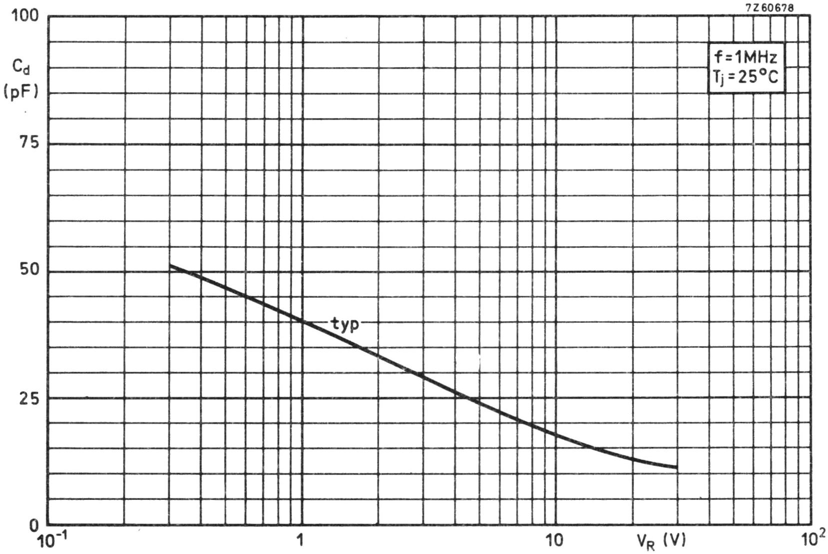
The leads must not be bent with a radius of less than 0.5 mm near the seal. (This can be done by hand if care is taken to exert no pulling force).

Soldering

At a maximum iron or solder temperature of 300 ^oC, the maximum permissible soldering time is 3 seconds. The soldering spot may be at any distance from the seal. During soldering, care must be taken that the plastic body does not come into contact with any temperature higher than 125 ^oC.


7Z60676
typical values
I_R (nA)
10
1
10^{-1}
10^{-2}
$T_j = 60^\circ C$
$25^\circ C$
1
10
V_R (V)
10^2


7Z60677
η = temperature coefficient of the diode capacitance
η (pF/pF / °C)
T_j = 0 to 60 °C
10^{-2}
10^{-3}
10^{-4}
10^{-5}
typ
1
10
V_R (V)
10^2


7Z60678
f = 1 MHz
T_j = 25 °C
C_d (pF)
100
75
50
25
0
typ
10^{-1}
1
10
V_R (V)
10^2

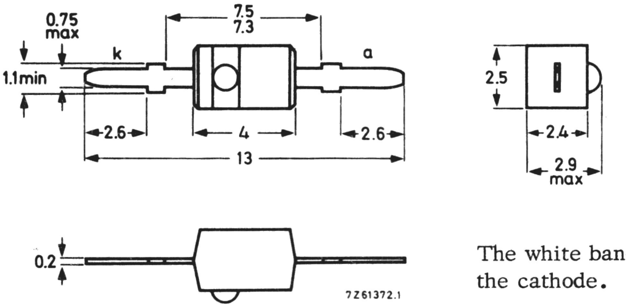
SILICON PLANAR VARIABLE CAPACITANCE DIODE

The BB117 is a variable capacitance diode in a plastic envelope. The diode is primarily intended for automatic frequency control in television receivers.

QUICK REFERENCE DATA				
Reverse voltage	V_R	max.	20	V
Reverse current at V_R = 20 V	I_R	<	100	nA
Diode capacitance at f = 0.5 MHz V_R = 15 V	C_d		2.2 to 5.0	pF
Capacitance ratio at f = 0.5 MHz	$\frac{C_d(V_R = 3\text{ V})}{C_d(V_R = 15\text{ V})}$		2.5 to 4.5	
Series resistance at f = 470 MHz V_R is that value at which C_d = 9 pF	r_D	<	1.2	Ω

MECHANICAL DATA

Dimensions in mm



The white band indicates the cathode.

The sealing of the plastic envelope withstands the accelerated damp heat test of IEC recommendation 68-2 (test D, severity IV, 6 cycles).

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

→ Continuous reverse voltage	V_R	max.	**20**	V
Forward current (d.c.)	I_F	max.	20	mA
Storage temperature	T_{stg}		-55 to +100	°C
Junction temperature	T_j	max.	60	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	0.4	°C/mW

CHARACTERISTICS

Tj = 25 °C unless otherwise specified

→ Reverse current

V_R = **20** V	I_R	<	100	nA
V_R = **20** V; T_j = 60 °C	I_R	<	500	nA

Diode capacitance at f = 0.5 MHz

V_R = 3 V	C_d	typ.	11.5	pF
V_R = 15 V	C_d		2.2 to 5.0	pF

Capacitance ratio at f = 0.5 MHz $\frac{C_d(V_R = 3\ V)}{C_d(V_R = 15\ V)}$ 2.5 to 4.5

Series resistance

at f = 470 MHz and at that value of V_R at which C_d = 9 pF	r_D	<	1.2	Ω

MOUNTING AND SOLDERING INSTRUCTIONS

Mounting

The leads must not be bent with a radius of less than 0.5 mm near the seal. (This can be done by hand if care is taken to exert no pulling force).

Soldering

At a maximum iron or solder temperature of 300 °C, the maximum permissible soldering time is 3 seconds. The soldering spot may be at any distance from the seal.
During soldering, care must be taken that the plastic body does not come into contact with any temperature higher than 125 °C.

Voltage regulator diodes

TYPE SELECTION CHART

Reference voltage ±5% V_Z (V)	400mW DO-7 glass	400mW DO-35 glass	400mW DO-7 glass	1W DO-15 plastic	1.5W DO-1 metal
	BZX75 *)				
1.4	–C1V4				
2.1	–C2V1				
2.8	–C2V8				
3.3	–		–C3V3		
3.6	–C3V6				
3.9					
4.3					
4.7		–C4V7			–C4V7
5.1					
5.6					
6.2					**BZY96series**
6.8					
7.5				–C7V5	
8.2					
9.1			**BZY88series**		–C9V1
10					–C10
11					
12					
13					
15					
16					
18		**BZX79series**			
20					
22					
24				**BZX61series**	
27					**BZY95series**
30			–C30		
33					
36					
39					
43					
47					
51					
56					
62					
68					
75		–C75		–C75	–C75

*) stabistors

Reference voltage ± 5% V_Z (V)	1.5 W DO-15 plastic	2.5 W plastic	10 W DO-4 metal	20 W DO-4 metal	75 W DO-5 metal
5.6	-C5V6		BZZ14	Reverse polarity available	
6.2			BZZ15		
6.8			BZZ16		
7.5			BZZ17	-C7V5(R)	
8.2			BZZ18		
9.1			BZZ19		
10		-C10	BZZ20		-C10(R)
11			BZZ21		
12			BZZ22		
13			BZZ23		
15			BZZ24		
16			BZZ25		
18	BZX29series		BZZ26		
20			BZZ27		
22			BZZ28		
24			BZZ29	BZY93series	
27		BZX70series			
30					BZY91series
33					
36					
39					
43					
47					
51					
56	-C56				
62					
68					
75		-C75		-C75(R)	-C75(R)

Special diodes with extremely low temperature coefficient

Type	Temperature coefficient S_Z (%/°C)	Reference voltage V_Z (V)	Envelope
BZX48	0.001	6.5	TO-18 (2 leads)
BZX49	0.002	6.5	TO-18 (2 leads)
BZX50	0.005	6.5	TO-18 (2 leads)
BZY78	0.005	5.3	DO-7

VOLTAGE TOLERANCES

The following tables give the voltage tolerances that belong to a specified type.

±5 % range

nom.	min.	max.	
2.7	2.5	2.9	V
3.0	2.8	3.2	V
3.3	3.1	3.5	V
3.6	3.4	3.8	V
3.9	3.7	4.1	V
4.3	4.0	4.6	V
4.7	4.4	5.0	V
5.1	4.8	5.4	V
5.6	5.2	6.0	V
6.2	5.8	6.6	V
6.8	6.4	7.2	V
7.5	7.0	7.9	V
8.2	7.7	8.7	V
9.1	8.5	9.6	V
10.0	9.4	10.6	V
11.0	10.4	11.6	V
12.0	11.4	12.7	V
13.0	12.4	14.1	V
15.0	13.8	15.6	V
16.0	15.3	17.1	V
18.0	16.8	19.1	V
20.0	18.8	21.2	V
22.0	20.8	23.3	V
24.0	22.8	25.6	V
27.0	25.1	28.9	V

±2 % range

nom.	min.	max.	
2.7	2.65	2.75	V
3.0	2.94	3.06	V
3.3	3.23	3.37	V
3.6	3.53	3.67	V
3.9	3.82	3.98	V
4.3	4.21	4.39	V
4.7	4.61	4.79	V
5.1	5.00	5.20	V
5.6	5.49	5.71	V
6.2	6.08	6.32	V
6.8	6.66	6.94	V
7.5	7.35	7.65	V
8.2	8.04	8.36	V
9.1	8.92	9.28	V
10.0	9.8	10.2	V
11.0	10.8	11.2	V
12.0	11.8	12.2	V
13.0	12.7	13.3	V
15.0	14.7	15.3	V
16.0	15.7	16.3	V
18.0	17.6	18.4	V
20.0	19.6	20.4	V
22.0	21.6	22.4	V
24.0	23.5	24.5	V
27.0	26.5	27.5	V

The values in tables above multiplied by 10 will be the values for higher voltages.

SILICON PLANAR VOLTAGE REFERENCE DIODES

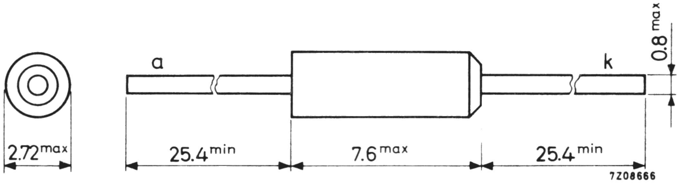
Silicon planar voltage reference diodes in a miniature cylindrical DO-15 plastic envelope intended for stabilization purposes.
The series covers the whole normalized range of nominal zener voltages from 5.6 V to 56 V with a tolerance of ± 5%.

QUICK REFERENCE DATA

Zener voltage range		nom.	5.6 to 56	V
Zener voltage tolerance			± 5	%
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1.5	W
Repetitive peak reverse power dissipation (square wave)	P_{ZRM}	max.	7.5	W
Junction temperature	T_j	max.	175	°C
Thermal resistance from junction to ambient	$R_{th\ j-a}$	=	100	°C/W

MECHANICAL DATA Dimensions in mm

DO-15



The coned end indicates the cathode

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

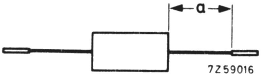
Repetitive peak forward current	I_{FRM}	max.	400	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1.5	W
Repetitive peak reverse power dissipation (square wave) t = 100 ms; δ = 0.001; T_{amb} = 25 °C	P_{ZRM}	max.	7.5	W
Storage temperature	T_{stg}		−65 to +175	°C
Junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

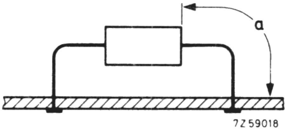
Effect of mounting on thermal resistance $R_{th\ j\text{-}a}$

The quoted values apply when no other leads run to the tie-points. If leads of other dissipating components share the same tie-points, the thermal resistance will be higher than that quoted.

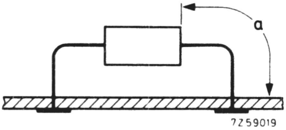
1. Mounted to solder tags at a lead-length a = 5 mm. $R_{th\ j\text{-}a}$ = 100 °C/W
2. Mounted to solder tags at a = maximum lead-length. $R_{th\ j\text{-}a}$ = 135 °C/W



3. Mounted on printed-wiring board with a small area of copper (< 0.25 cm^2) at any lead length a. $R_{th\ j\text{-}a}$ = 150 °C/W



4. Mounted on printed-wiring board with a large area of copper ($\geq$1.5 cm^2) at any lead length a. $R_{th\ j\text{-}a}$ = 80 °C/W



SOLDERING AND MOUNTING NOTES

1. Soldered joints must be at least 5 mm from the seal.
2. The maximum permissible temperature of the soldering iron or bath is 300 °C ; it must be in contact with the joint for no more than 3 seconds.
3. Avoid hot spots due to handling or mounting; the body of the device must not come into contact with or be exposed to a temperature higher than 150 °C.

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Forward voltage at I_F = 200 mA V_F < 1.5 V

Reverse current at

		BZX29-	C5V6 to C6V2	C6V8 to C10	C11 to C56	
V_R = 2 V	I_R	<	10			μA
$V_R = \frac{2}{3} \cdot V_{Znom}$	I_R	<		10	5	μA

Zener voltage V_Z

BZX29-	min.	nom.	max.	min.	typ.	typ.	max.
	at I_Z = 50 mA			at I_Z = 1 mA		at I_Z = 100 mA	
C5V6	5.3	5.6	6.0 V	4.4	5.1 V	5.9	6.5 V
C6V2	5.8	6.2	6.6 V	5.0	6.0 V	6.4	7.0 V
	at I_Z = 20 mA					at I_Z = 40 mA	
C6V8	6.4	6.8	7.2 V	5.6	6.6 V	6.9	7.5 V
C7V5	7.1	7.5	7.9 V	6.3	7.3 V	7.6	8.5 V
C8V2	7.7	8.2	8.7 V	6.8	8.0 V	8.4	9.0 V
C9V1	8.6	9.1	9.6 V	7.8	8.9 V	9.3	10.0 V
C10	9.4	10	10.6 V	8.5	9.9 V	10.2	11.0 V
C11	10.4	11	11.6 V	9.5	10.8 V	11.2	12.5 V
C12	11.4	12	12.6 V	10	11.5 V	12.5	13.5 V
C13	12.4	13	14.1 V	11	12.6 V	13.5	15.0 V
C15	13.9	15	15.6 V	12.5	14.5 V	15.5	16.5 V
	at I_Z = 10 mA			at I_Z = 0.25 mA		at I_Z = 20 mA	
C16	15.4	16	17.1 V	14	15.8 V	16.5	18 V
C18	16.9	18	19.1 V	15.5	17.5 V	18.5	20 V
C20	18.9	20	21.2 V	17.5	19.5 V	20.7	23 V
C22	20.8	22	23.3 V	19.5	21.4 V	22.7	25 V
C24	22.7	24	25.9 V	21	23.3 V	24.8	28 V
C27	25.1	27	28.9 V	24	26.2 V	27.8	30 V
C30	28	30	32 V	26	29.2 V	30.8	34 V
	at I_Z = 5 mA					at I_Z = 10 mA	
C33	31	33	35 V	29	32.6 V	33.4	37 V
C36	34	36	38 V	32	35.6 V	36.5	40 V
C39	37	39	41 V	35	38.5 V	39.5	43 V
C43	40	43	45 V	38	42.5 V	43.5	48 V
C47	44	47	50 V	42	46.4 V	47.7	53 V
C51	48	51	54 V	46	50.4 V	51.8	57 V
C56	53	56	60 V	50	55.3 V	57	64 V

CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

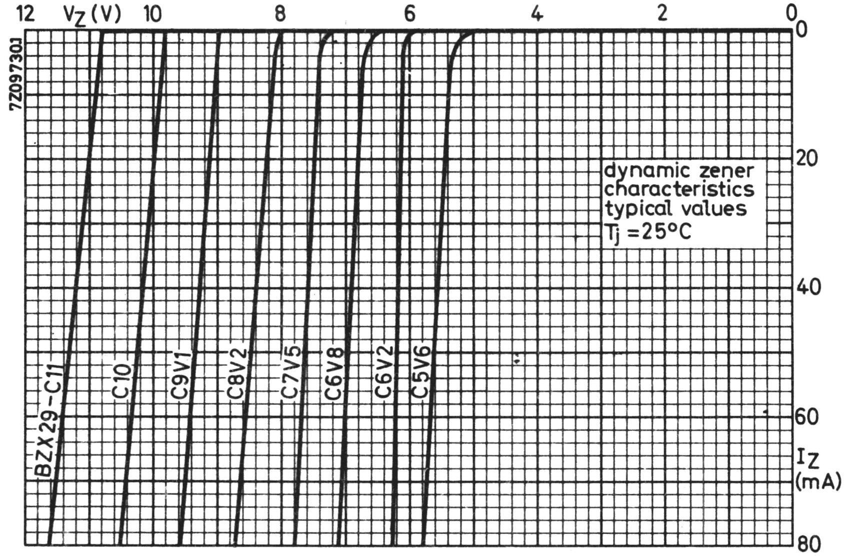
Differential resistance r_Z

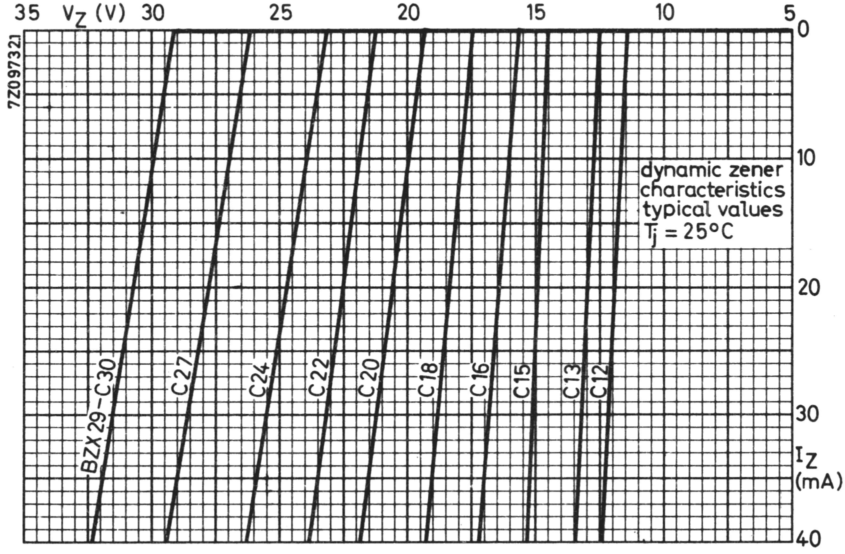
BZX29-	typ.	max.	typ.	max.	typ.	max.
	at I_Z = 50 mA		at I_Z = 1 mA		at I_Z = 100 mA	
C5V6	1.8	5 Ω	90	600 Ω	1.5	4 Ω
C6V2	0.7	2 Ω	15	700 Ω	0.6	1.5 Ω
	at I_Z = 20 mA				at I_Z = 40 mA	
C6V8	2.9	3.5 Ω	100	700 Ω	2.1	3.2 Ω
C7V5	3.0	4.4 Ω	100	700 Ω	2.2	3.5 Ω
C8V2	3.2	4.5 Ω	100	700 Ω	2.3	4.0 Ω
C9V1	3.5	5 Ω	110	700 Ω	2.5	4.5 Ω
C10	4	7 Ω	110	700 Ω	2.7	6 Ω
C11	5	8 Ω	120	700 Ω	3	7 Ω
C12	5	9 Ω	130	700 Ω	3	8 Ω
C13	5.5	10 Ω	140	700 Ω	3	9 Ω
C15	7	14 Ω	150	700 Ω	4.5	12 Ω
	at I_Z = 10 mA		at I_Z = 0.25 mA		at I_Z = 20 mA	
C16	10	16 Ω	200	700 Ω	7	14 Ω
C18	13	20 Ω	250	750 Ω	9	18 Ω
C20	15	22 Ω	300	750 Ω	10	20 Ω
C22	16	23 Ω	350	750 Ω	11	22 Ω
C24	20	25 Ω	400	750 Ω	16	24 Ω
C27	23	35 Ω	420	750 Ω	17	30 Ω
C30	24	40 Ω	450	1000 Ω	18	35 Ω
	at I_Z = 5 mA				at I_Z = 10 mA	
C33	38	45 Ω	500	1000 Ω	22	40 Ω
C36	40	50 Ω	700	1000 Ω	25	45 Ω
C39	42	60 Ω	750	1000 Ω	27	50 Ω
C43	45	70 Ω	800	1500 Ω	30	60 Ω
C47	50	80 Ω	900	1500 Ω	35	70 Ω
C51	60	95 Ω	1000	1500 Ω	40	80 Ω
C56	65	110 Ω	1100	2000 Ω	45	90 Ω

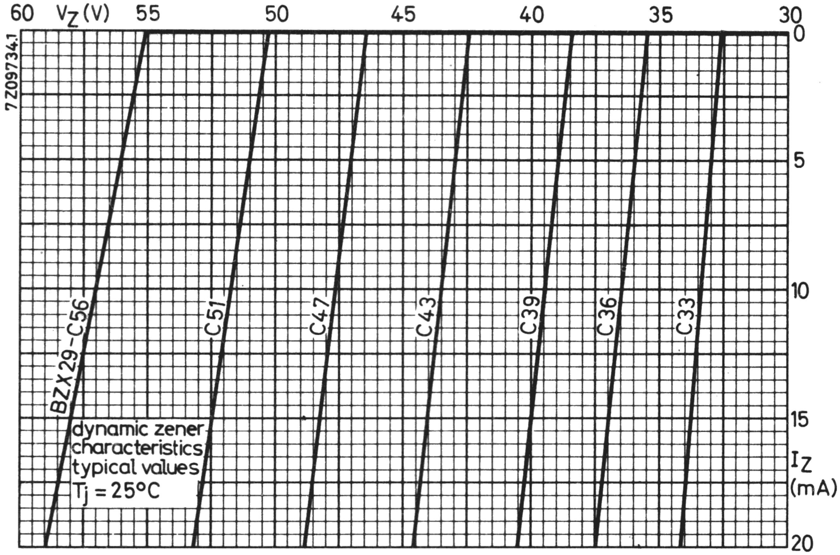
CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

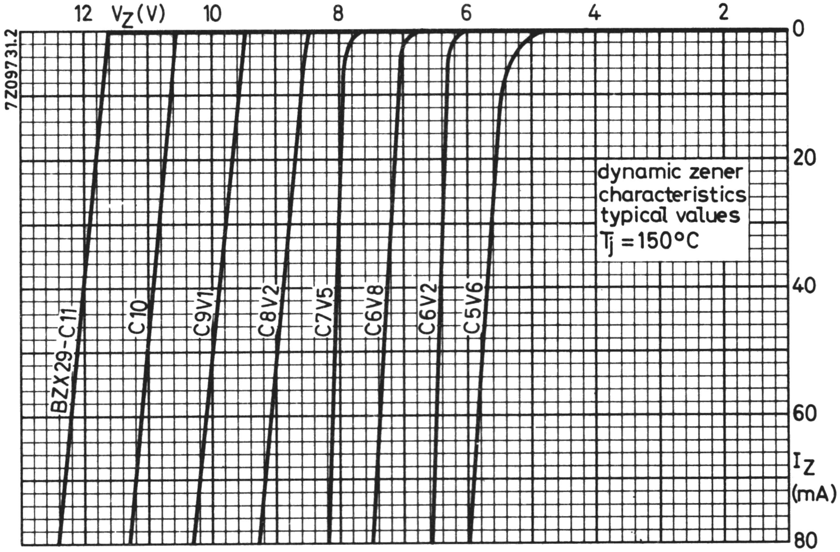
Temperature coefficient S_Z and diode capacitance C_d

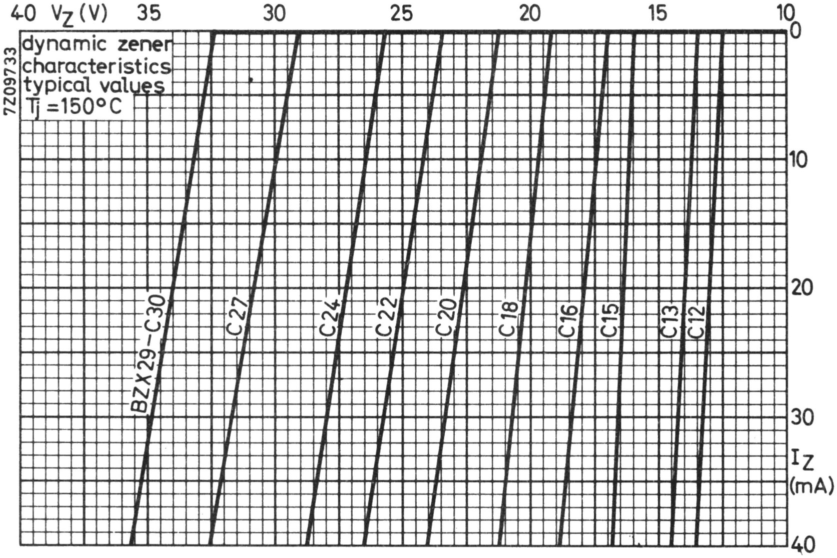
BZX29-	S_Z typ. at I_Z = 50 mA	S_Z typ. at I_Z = 1 mA	S_Z typ. at I_Z = 100 mA	C_d typ. at V_R = 2 V
C5V6	+1.1 mV/°C	−0.6 mV/°C	+2.0 mV/°C	700 pF
C6V2	+2.2 mV/°C	+1.6 mV/°C	+2.2 mV/°C	700 pF
	at I_Z = 20 mA		at I_Z = 40 mA	
C6V8	+2.7 mV/°C	+2.2 mV/°C	+2.7 mV/°C	700 pF
C7V5	+3.4 mV/°C	+3.4 mV/°C	+3.4 mV/°C	480 pF
C8V2	+3.9 mV/°C	+3.9 mV/°C	+3.9 mV/°C	480 pF
C9V1	+4.65 mV/°C	+4.63 mV/°C	+4.65 mV/°C	380 pF
C10	+5.5 mV/°C	+5.5 mV/°C	+5.5 mV/°C	380 pF
C11	+6.6 mV/°C	+6.6 mV/°C	+6.6 mV/°C	320 pF
C12	+7.8 mV/°C	+7.8 mV/°C	+7.8 mV/°C	310 pF
C13	+8.45 mV/°C	+8.45 mV/°C	+8.45 mV/°C	280 pF
C15	+10.5 mV/°C	+10.5 mV/°C	+10.5 mV/°C	240 pF
	at I_Z = 10 mA	at I_Z = 0.25 mA	at I_Z = 20 mA	
C16	+11.2 mV/°C	+11.2 mV/°C	+11.2 mV/°C	210 pF
C18	+13.5 mV/°C	+13.5 mV/°C	+13.5 mV/°C	200 pF
C20	+15.0 mV/°C	+13.5 mV/°C	+15.0 mV/°C	180 pF
C22	+17.6 mV/°C	+17.6 mV/°C	+17.6 mV/°C	170 pF
C24	+19.2 mV/°C	+19.2 mV/°C	+19.2 mV/°C	160 pF
C27	+23.0 mV/°C	+23.0 mV/°C	+23.0 mV/°C	150 pF
C30	+25.5 mV/°C	+25.5 mV/°C	+25.5 mV/°C	130 pF
	at I_Z = 5 mA		at I_Z = 10 mA	
C33	+28.0 mV/°C	+28.0 mV/°C	+28.0 mV/°C	120 pF
C36	+30.5 mV/°C	+30.5 mV/°C	+30.5 mV/°C	120 pF
C39	+35.0 mV/°C	+35.0 mV/°C	+35.0 mV/°C	110 pF
C43	+38.5 mV/°C	+38.5 mV/°C	+38.5 mV/°C	100 pF
C47	+42.5 mV/°C	+42.5 mV/°C	+42.5 mV/°C	100 pF
C51	+46.0 mV/°C	+46.0 mV/°C	+46.0 mV/°C	90 pF
C56	+50.5 mV/°C	+50.5 mV/°C	+50.5 mV/°C	85 pF

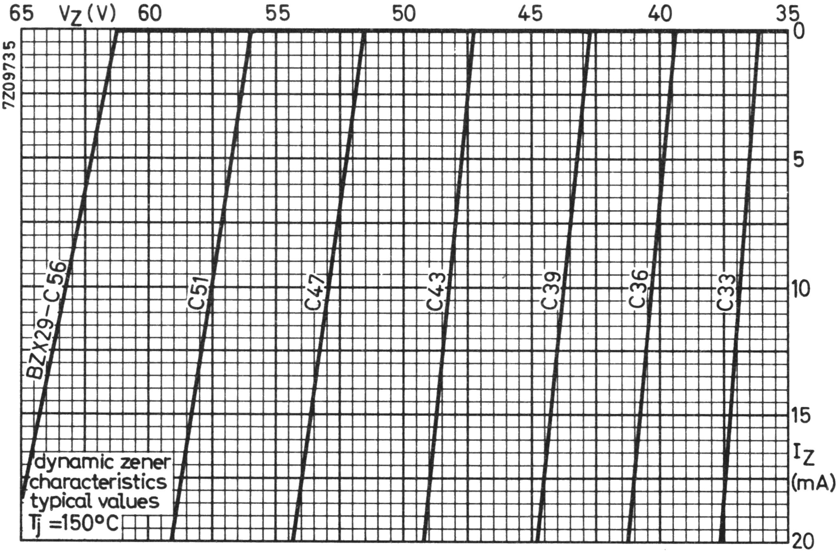

7Z09730.1
12
V_Z (V)
10
8
6
4
2
0
0
20
40
60
I_Z (mA)
80
BZX29–C11
C10
C9V1
C8V2
C7V5
C6V8
C6V2
C5V6
dynamic zener characteristics typical values T_j = 25°C

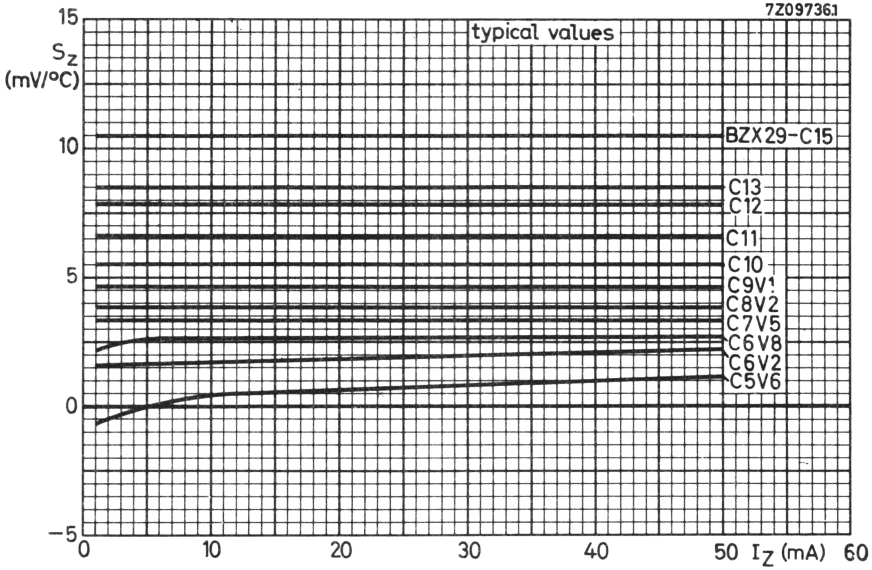

7Z09732.1
35
V_Z (V)
30
25
20
15
10
5
0
10
20
30
I_Z (mA)
40
BZX29–C30
C27
C24
C22
C20
C18
C16
C15
C13
C12
dynamic zener characteristics typical values T_j = 25°C

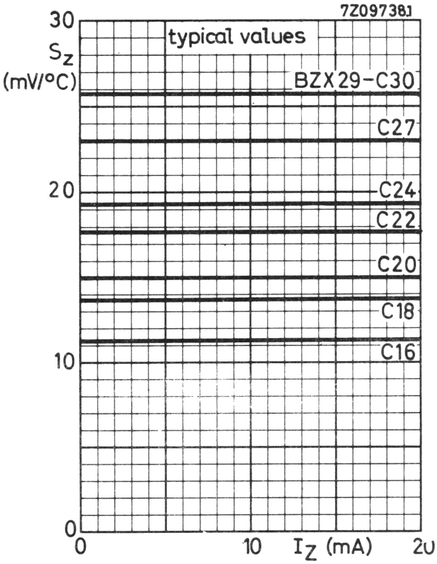

60
V_Z(V)
55
50
45
40
35
30
7Z09734.1
0
5
10
15
20
I_Z (mA)
BZX29-C56
C51
C47
C43
C39
C36
C33
dynamic zener characteristics typical values T_j = 25°C

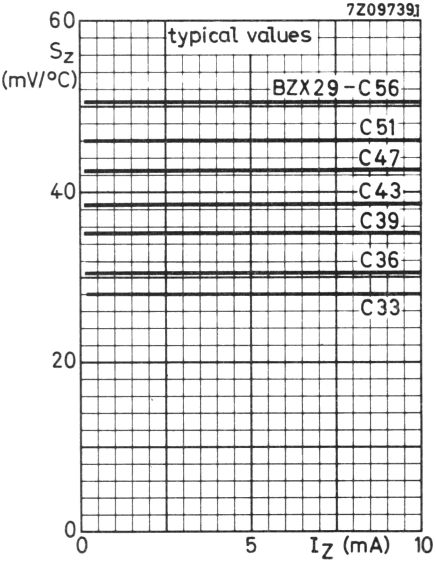

12
V_Z(V)
10
8
6
4
2
7Z09731.2
0
20
40
60
80
I_Z (mA)
BZX29-C11
C10
C9V1
C8V2
C7V5
C6V8
C6V2
C5V6
dynamic zener characteristics typical values T_j = 150°C

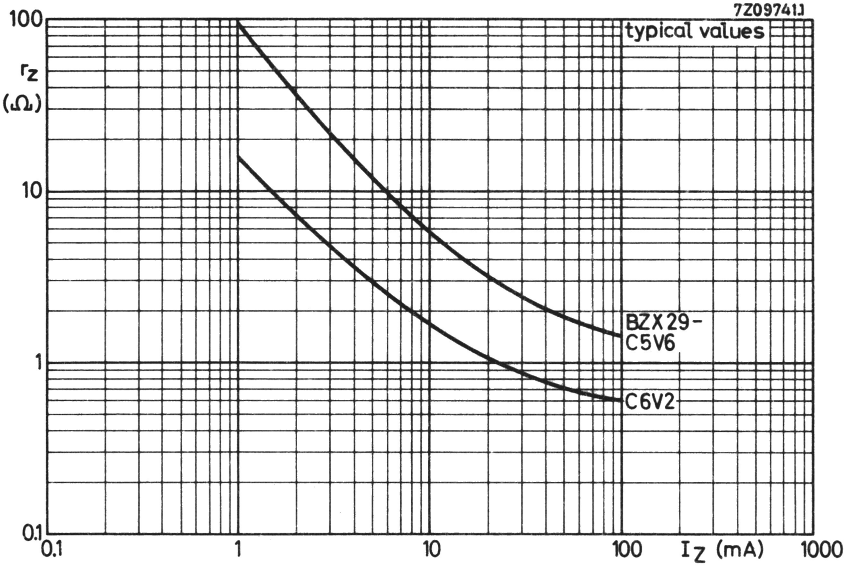

40 V_Z (V) 35 30 25 20 15 10
7Z09733
dynamic zener characteristics typical values T_j =150°C
BZX29–C30
C27
C24
C22
C20
C18
C16
C15
C13
C12
0
10
20
30
I_Z (mA)
40

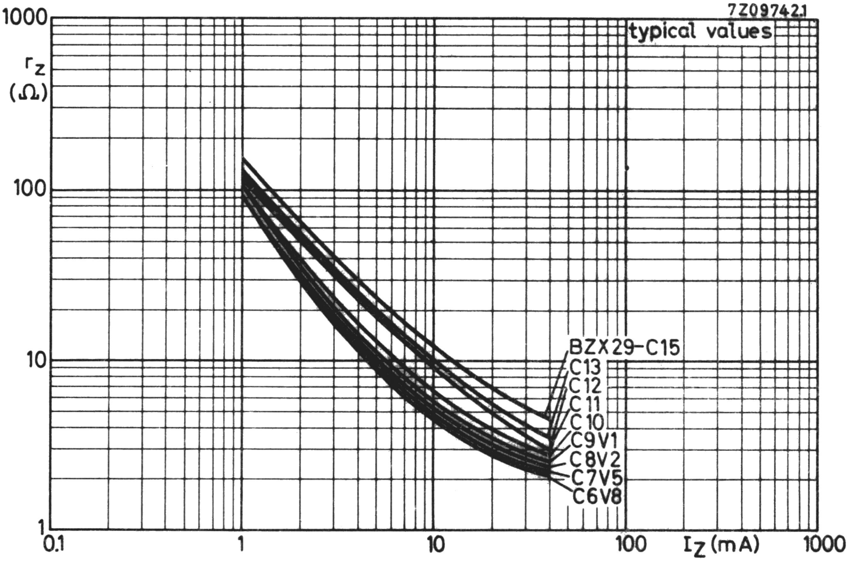

65 V_Z (V) 60 55 50 45 40 35
7Z09735
BZX29–C56
C51
C47
C43
C39
C36
C33
dynamic zener characteristics typical values T_j =150°C
0
5
10
15
I_Z (mA)
20

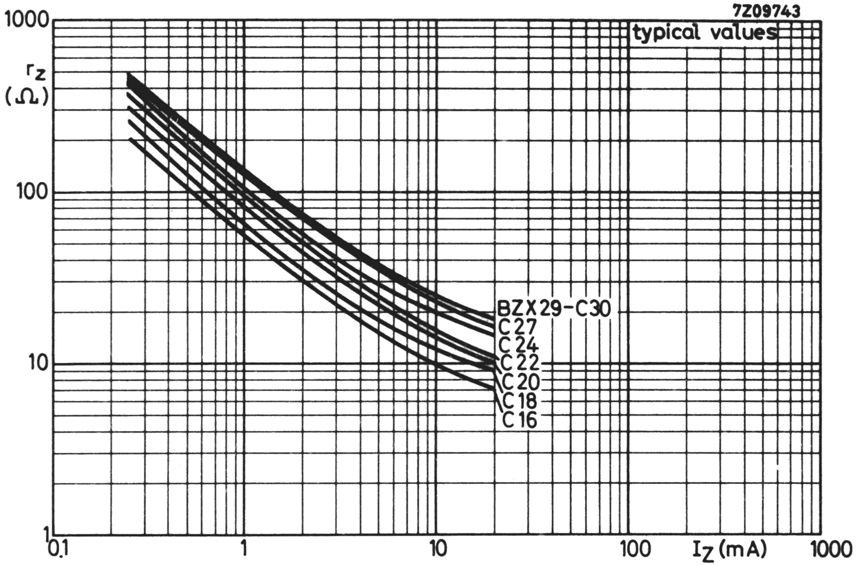

7Z09736.1
typical values
15
S_Z
(mV/°C)
10
5
0
−5
0
10
20
30
40
50
60
I_Z (mA)
BZX29-C15
C13
C12
C11
C10
C9V1
C8V2
C7V5
C6V8
C6V2
C5V6

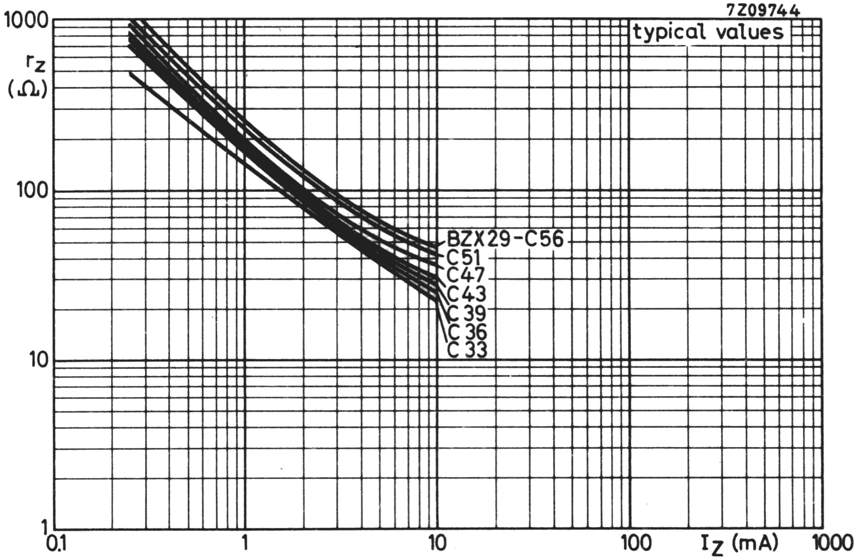

7Z09738.1
typical values
30
S_Z
(mV/°C)
20
10
0
0
10
20
I_Z (mA)
BZX29-C30
C27
C24
C22
C20
C18
C16

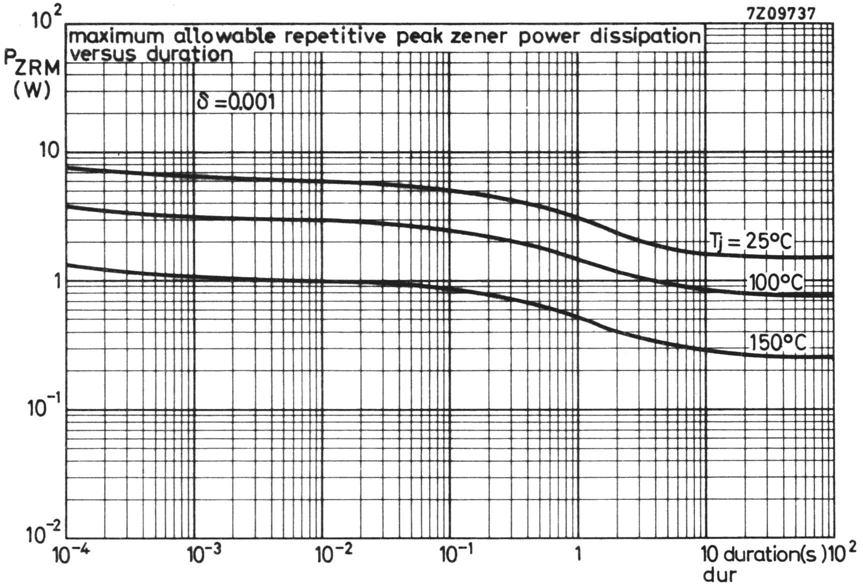

7Z09739.1
typical values
60
S_Z
(mV/°C)
40
20
0
0
5
10
I_Z (mA)
BZX29-C56
C51
C47
C43
C39
C36
C33

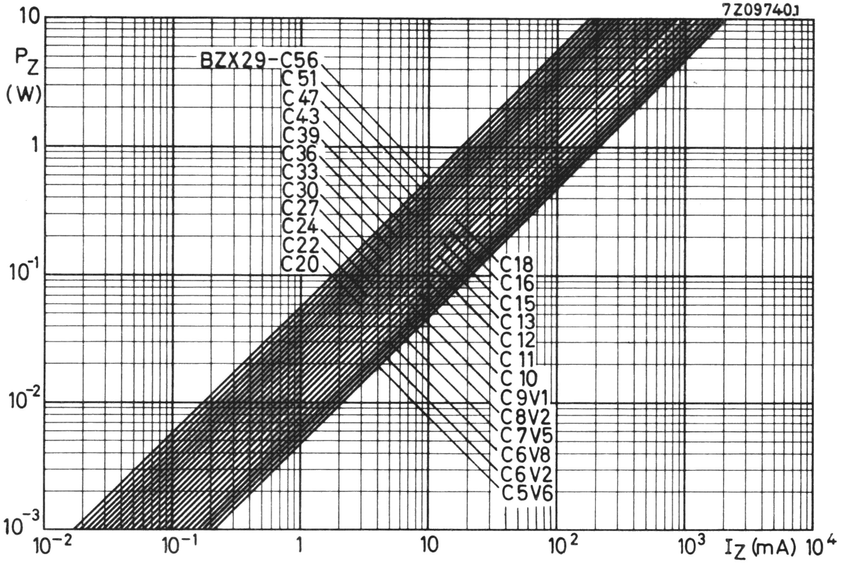

7Z09741.1
typical values
r_z (Ω)
100
10
1
0.1
0.1
1
10
100
I_Z (mA)
1000
BZX29-
C5V6
C6V2

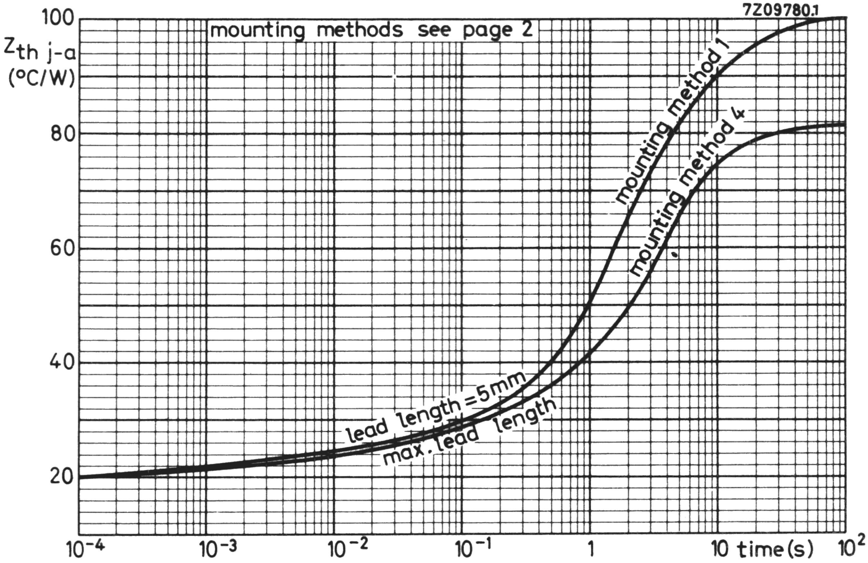

7Z09742.1
typical values
r_z (Ω)
1000
100
10
1
0.1
1
10
100
I_Z (mA)
1000
BZX29-C15
C13
C12
C11
C10
C9V1
C8V2
C7V5
C6V8


7Z09743
typical values
r_Z (Ω)
1000
100
10
1
0.1
1
10
100
I_Z (mA)
1000
BZX29-C30
C27
C24
C22
C20
C18
C16


7Z09744
typical values
r_Z (Ω)
1000
100
10
1
0.1
1
10
100
I_Z (mA)
1000
BZX29-C56
C51
C47
C43
C39
C36
C33


7Z09737
maximum allowable repetitive peak zener power dissipation versus duration
P_{ZRM} (W)
δ = 0.001
10^2
10
1
10^{-1}
10^{-2}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
duration(s)
10^2
dur
T_j = 25°C
100°C
150°C


7Z09740
P_Z (W)
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
10^3
I_Z (mA)
10^4
BZX29-C56
C51
C47
C43
C39
C36
C33
C30
C27
C24
C22
C20
C18
C16
C15
C13
C12
C11
C10
C9V1
C8V2
C7V5
C6V8
C6V2
C5V6


7Z09780.1
100
$Z_{th\ j-a}$
(°C/W)
80
60
40
20
mounting methods see page 2
mounting method 1
mounting method 4
lead length = 5mm
max. lead length
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10 time (s)
10^2

VOLTAGE REFERENCE DIODES

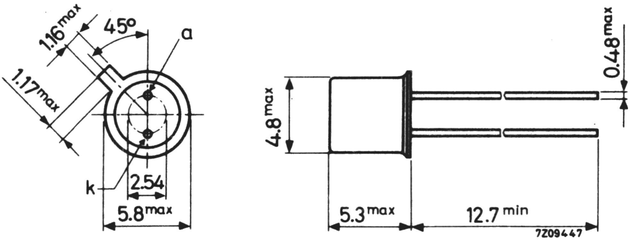
Silicon planar voltage reference diodes in a metal envelope. They have a very low temperature coefficient and are primarily intended for use as reference sources in in measurement equipment such as digital voltmeters.

QUICK REFERENCE DATA

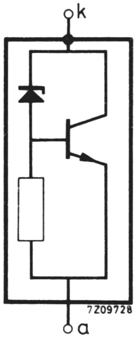
Zener voltage at I_Z = 2.0 mA	V_Z	nom.	6.5	V
Zener voltage tolerance			± 5	%
Temperature coefficient at I_Z = 2.0 mA				
BZX48:	S_Z	<	+0.065	mV/°C
BZX49:	S_Z	<	+0.13	mV/°C
BZX50:	S_Z	<	+0.325	mV/°C
Recommended operating ambient temperature range	T_{amb}		0 to +70	°C

MECHANICAL DATA Dimensions in mm

Except for the two leads only, conforming to TO-18


1.16max
45°
a
1.17max
k
2.54
5.8max
4.8max
0.48max
5.3max
12.7min
7Z09447

Cathode connected to case



RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Currents

Zener current (d.c.)	I_Z	max.	10	mA
Zener current (peak value)	I_{ZM}	max.	10	mA

Temperatures

Storage temperature	T_{stg}	−65 to +150	°C
Operating ambient temperature	T_{amb}	−65 to +100	°C

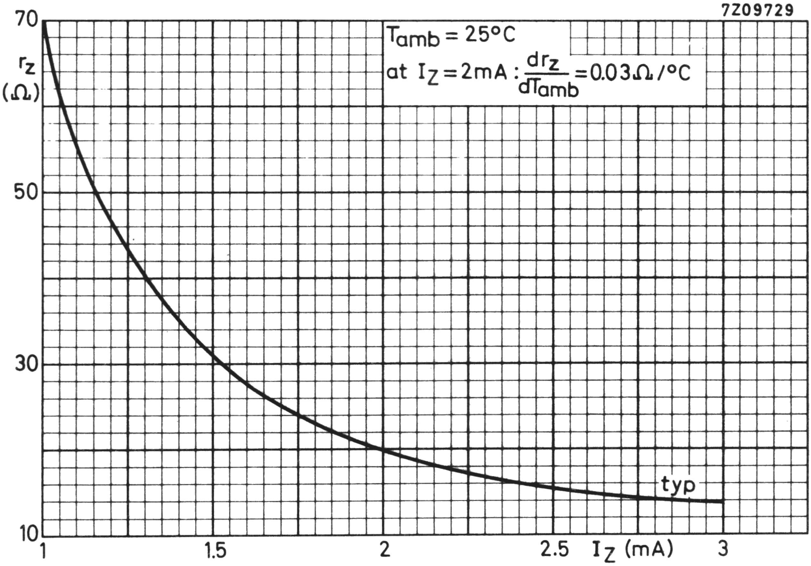
CHARACTERISTICS T_{amb} = 25 °C unless otherwise specified

Zener voltage at					
I_Z = 1.0 mA		V_Z	typ.	6.42	V
I_Z = 2.0 mA		V_Z	typ.	6.45	V
			6.1 to	6.9	V
I_Z = 3.0 mA		V_Z	typ.	6.47	V
Reverse current at V_R = 4.0 V		I_R	typ.	0.1	μA
			<	1.0	μA
Temperature coefficient at I_Z = 2.0 mA					
T_{amb} = 0 to 70 °C	BZX48:	S_Z	<	+0.065	mV/°C
	BZX49:	S_Z	<	+0.13	mV/°C
	BZX50:	S_Z	<	+0.325	mV/°C
I_Z = 1 to 3 mA					
	BZX48:	S_Z	<	+0.13	mV/°C
	BZX49:	S_Z	<	+0.325	mV/°C
	BZX50:	S_Z	<	+0.65	mV/°C
Differential resistance at I_Z = 1.0 mA		r_Z	typ.	70	Ω
			<	125	Ω
I_Z = 2.0 mA		r_Z	typ.	20	Ω
			10 to	50	Ω
I_Z = 3.0 mA		r_Z	typ.	14	Ω
			<	25	Ω

OPERATING NOTES

Recommended operating temperature range T_{amb} = 0 to +70 °C
Optimum operating zener current $I_{Z\,opt}$ = 2.0 ± 5% mA.

The tolerance given is that which will not significantly affect the temperature coefficient. Changes due to differential resistance must still be taken into account.


7Z09729
$T_{amb} = 25°C$
at $I_Z = 2mA : \frac{dr_Z}{dT_{amb}} = 0.03 \Omega/°C$
r_Z (Ω)
70
50
30
10
1
1.5
2
2.5
I_Z (mA)
3
typ

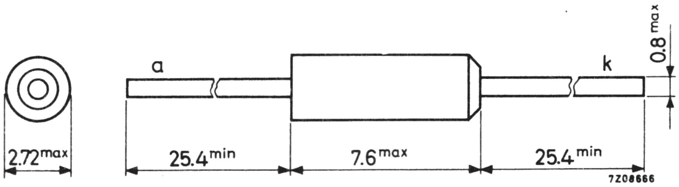
VOLTAGE REGULATOR DIODES

Silicon diodes in a DO-15 plastic envelope intended for general purpose use as low power voltage regulators.
The series consists of 26 types with nominal zener voltages ranging from 7.5 V to 75 V with a tolerance of ±5%.

QUICK REFERENCE DATA				
Zener voltage range		nom.	7.5 to 75	V
Zener voltage tolerance			±5	%
Peak zener current	I_{ZM}	max.	3	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1	W
Junction temperature	T_j	max.	175	°C
Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	0.15	°C/mW

MECHANICAL DATA Dimensions in mm

DO-15



The coned end indicates the cathode

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Currents

Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	1	A
Peak zener current	I_{ZM}	max.	3	A

Power dissipation

Total power dissipation up to $T_{amb} = 25\,^{\circ}C$	P_{tot}	max.	1	W

Temperatures

Storage temperature	T_{stg}		−65 to +175	°C
Junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.15	°C/mW

CHARACTERISTICS

$T_j = 25\,^{\circ}C$ unless otherwise specified

Forward voltage

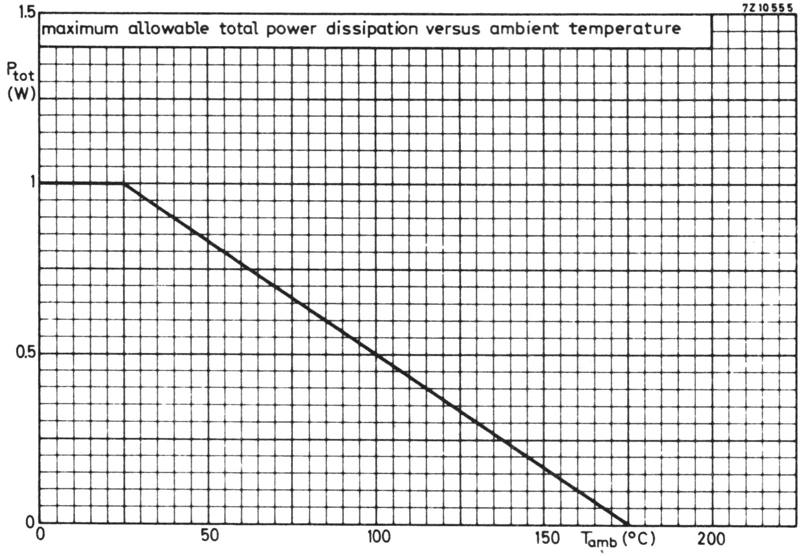
$I_F = 100$ mA; $T_{amb} = 25\,^{\circ}C$	V_F	typ.	0.86	V
		<	1.1	V

Reverse current

			BZX61-C7V5 to 8V2	C9V1	C10 to C75	
$V_R = 3$ V	I_R	<	10	–	–	μA
$V_R = 5$ V	I_R	<	–	10	–	μA
$V_R = \frac{2}{3} \cdot V_{Z\ nom}$	I_R	<	–	–	5	μA

CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

BZX61-...	Zener voltage V_Z at I_Z = 20 mA			Temperature coefficient at I_Z = 20 mA	Differential resistance at I_Z = 20 mA
	min.	nom.	max.	typ.	max.
C7V5	7.1	7.5	7.9 V	+3.0 mV/°C	6.0 Ω
C8V2	7.8	8.2	8.7 V	+3.3 mV/°C	7.5 Ω
C9V1	8.6	9.1	9.6 V	+4.6 mV/°C	8.0 Ω
C10	9.4	10	10.6 V	+5.0 mV/°C	8.5 Ω
C11	10.4	11	11.6 V	+5.5 mV/°C	9.0 Ω
C12	11.4	12	12.6 V	+6.0 mV/°C	9.0 Ω
C13	12.4	13	14.1 V	+6.5 mV/°C	10 Ω
C15	13.9	15	15.6 V	+9.0 mV/°C	14 Ω
	at I_Z = 10 mA			at I_Z = 10 mA	at I_Z = 10 mA
	min.	nom.	max.	typ.	max.
C16	15.4	16	17.1 V	+10 mV/°C	16 Ω
C18	16.9	18	19.1 V	+11 mV/°C	20 Ω
C20	18.9	20	21.2 V	+12 mV/°C	22 Ω
C22	20.8	22	23.3 V	+13 mV/°C	23 Ω
C24	22.7	24	25.9 V	+14 mV/°C	25 Ω
C27	25.1	27	28.9 V	+16 mV/°C	35 Ω
C30	28	30	32 V	+21 mV/°C	40 Ω
C33	31	33	35 V	+23 mV/°C	45 Ω
C36	34	36	38 V	+25 mV/°C	50 Ω
	at I_Z = 5 mA			at I_Z = 5 mA	at I_Z = 5 mA
	min.	nom.	max.	typ.	max.
C39	37	39	41 V	+27 mV/°C	60 Ω
C43	40	43	45 V	+30 mV/°C	70 Ω
C47	44	47	50 V	+38 mV/°C	80 Ω
C51	48	51	54 V	+41 mV/°C	95 Ω
C56	53	56	60 V	+45 mV/°C	105 Ω
C62	58	62	66 V	+50 mV/°C	110 Ω
C68	64	68	72 V	+54 mV/°C	120 Ω
C75	71	75	79 V	+60 mV/°C	135 Ω



SOLDERING AND MOUNTING NOTES

1. Soldered joints must be at least 5 mm from the seal.
2. The maximum permissible temperature of the soldering iron or bath is 245 °C; it must be in contact with the joint for no more than 5 seconds.
3. Avoid hot spots due to handling or mounting; the body of the device must not come into contact with or be exposed to a temperature higher than 175 °C.

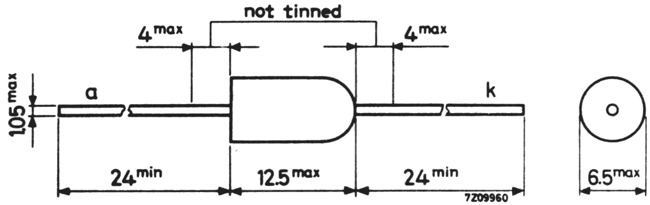
VOLTAGE REGULATOR DIODES

Silicon diodes in a plastic envelope for general purpose use as medium power voltage stabilizers or voltage references.
The series consist of 22 types with nominal zener voltages ranging from 10 V to 75 V with a tolerance of ±5%.

QUICK REFERENCE DATA				
Zener voltage range		nom.	10 to 75	V
Zener voltage tolerance			± 5	%
Repetitive peak zener current	I_{ZRM}	max.	5	A
Total power dissipation up to $T_{amb} = 25\,^{o}C$	P_{tot}	max.	2.5	W
Non repetitive peak reverse power	P_{ZSM}	max.	100	W
Junction temperature	T_j	max.	150	°C
Thermal resistance from junction to ambient with 10 mm tie points on an infinite heatsink	$R_{th\ j-a}$	=	50	°C/W

MECHANICAL DATA

Dimensions in mm



The rounded end indicates the cathode

The sealing of the plastic envelope withstands the accelerated damp heat test of IEC recommendation 68-2 (test D, severity IV, 6 cycles).

MOUNTING METHODS see page 6.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Currents

Forward current (averaged over any 20 ms period)	I_{FAV}	max.	1	A
Repetitive peak forward current	I_{FRM}	max.	3	A
Repetitive peak zener current	I_{ZRM}	max.	5	A

Power dissipation

Total power dissipation up to T_{amb} = 25 °C with max. lead length; mounting method 2 (see pages 6 and 11)	P_{tot}	max.	1.75	W
with 10 mm tie points on infinite heatsink (see page 11)	P_{tot}	max.	2.5	W
Non repetitive peak reverse power	P_{ZSM}	max.	100	W

Temperatures

Storage temperature	T_{stg}		-65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE (see pages 6 and 11)

From junction to ambient

with max. lead length: mounting method 2	$R_{th\ j\text{-}a}$	=	70	°C/W
with 10 mm tie points: mounting method 1	$R_{th\ j\text{-}a}$	=	60	°C/W
with 10 mm tie points mounted on infinite heatsink	$R_{th\ j\text{-}a}$	=	50	°C/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Forward voltage at $I_F = 1.0$ A	V_F	<	1.5 V
Reverse current at $V_R = \frac{2}{3} \cdot V_{Z\,nom}$	I_R	<	10 μA

BZX70-...	Zener voltage V_Z at I_Z = 50 mA			Temperature coefficient S_Z at I_Z = 50 mA	Differential resistance r_Z at I_Z = 50 mA	
	min.	nom.	max.	typ.	typ.	max.
C10	9.4	10	10.6 V	7.0 mV/°C	0.75	4.0 Ω
C11	10.4	11	11.6 V	7.5 mV/°C	0.80	4.5 Ω
C12	11.4	12	12.6 V	8.0 mV/°C	0.85	5.0 Ω
C13	12.4	13	14.1 V	8.5 mV/°C	0.90	6.0 Ω
C15	13.9	15	15.6 V	10.0 mV/°C	1.0	8.0 Ω
	at I_Z = 20 mA			at I_Z = 20 mA	at I_Z = 20 mA	
	min.	nom.	max.	typ.	typ.	max.
C16	15.4	16	17.1 V	11 mV/°C	2.4	9 Ω
C18	16.9	18	19.1 V	12 mV/°C	2.5	11 Ω
C20	18.9	20	21.2 V	14 mV/°C	2.8	12 Ω
C22	20.8	22	23.3 V	16 mV/°C	3.0	13 Ω
C24	22.7	24	25.9 V	18 mV/°C	3.4	14 Ω
C27	25.1	27	28.9 V	20 mV/°C	3.8	18 Ω
C30	28	30	32 V	25 mV/°C	4.5	22 Ω
C33	31	33	35 V	30 mV/°C	5.0	25 Ω
C36	34	36	38 V	32 mV/°C	5.5	30 Ω
	at I_Z = 10 mA			at I_Z = 10 mA	at I_Z = 10 mA	
	min.	nom.	max.	typ.	typ.	max.
C39	37	39	41 V	35 mV/°C	12	35 Ω
C43	40	43	45 V	40 mV/°C	13	40 Ω
C47	44	47	50 V	45 mV/°C	14	50 Ω
C51	48	51	54 V	50 mV/°C	15	55 Ω
C56	53	56	60 V	55 mV/°C	17	63 Ω
C62	58	62	66 V	60 mV/°C	18	75 Ω
C68	64	68	72 V	65 mV/°C	18	90 Ω
C75	71	75	79 V	70 mV/°C	20	100 Ω

OPERATING NOTES

1. Dissipation and heatsink considerations

a. Steady-state conditions

The maximum allowable steady-state dissipation $P_{S\,max}$ is given by the relationship

$$P_{S\,max} = \frac{T_{j\,max} - T_{amb}}{R_{th\,j\text{-}a}}$$

where $T_{j\,max}$ is the maximum permissible operating junction temperature.
T_{amb} is the ambient temperature,
$R_{th\,j\text{-}a}$ is the total thermal resistance from junction to ambient

b. Pulse conditions (see fig. next page)

The maximum allowable additional pulse power $P_{m\,max}$ is given by the formula

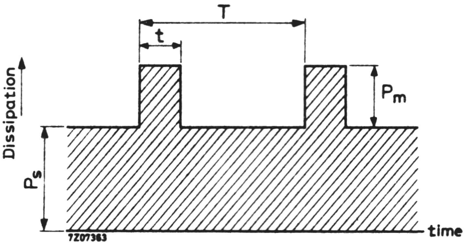
$$P_{m\,max} = \frac{(T_{j\,max} - T_{amb}) - (P_S \cdot R_{th\,j\text{-}a})}{Z_{th\,j\text{-}a}}$$

where P_S is the steady-state dissipation, excluding that in the pulses,
$Z_{th\,j\text{-}a}$ is the effective thermal impedance of the device from junction to ambient. It is a function of the pulse duration t and duty cycle δ (see page 10)

δ is the duty cycle and is equal to the pulse duration t divided by the period duration T.

The steady-state power P_S when biased in the zener direction at a given zener current can be found from page 11, lower figure. With the additional pulsed power dissipation $P_{m\,max}$ calculated from the above expression, the total repetitive peak zener power dissipation $P_{ZRM} = P_S + P_{m\,max}$. From page 11, lower figure the corresponding maximum repetitive peak zener current at P_{ZRM} can now be read. This repetitive peak zener current is subject to the absolute maximum rating. For pulse durations longer than the temperature stabilization time of the diode t_{stab}, the maximum allowable repetitive peak dissipation P_{ZRM} is equal to the maximum steady-state power $P_{S\,max}$. The temperature stabilization time for the BZX70series is 100 s (see page 10).

OPERATING NOTES (continued)



Example

The following example illustrates how to calculate the maximum permissible repetitive peak zener current of a BZX70-C30 zener diode mounted on a printed circuit board with max. lead length at a maximum ambient temperature of 60 °C. The steady-state zener current is 25 mA, the duty cycle $\delta = 0.1$ and the pulse duration $t = 1$ ms.

The steady-state dissipation P_s at a zener current of 25 mA (from page 11, lower figure) = 0.9 W.
The thermal resistance from junction to ambient $R_{th\ j\text{-}a} = 85$ °C/W (mounting method 3 on page 6).
The thermal impedance $Z_{th\ j\text{-}a}$ with a duty cycle $\delta = 0.1$ and a pulse duration $t = 1$ ms (from page 10, lower figure).

$$Z_{th\ j\text{-}a} = 9.2\ ^{\circ}\text{C/W}$$

The maximum additional pulse power dissipation

$$P_{m\ max} = \frac{(T_{j\ max} - T_{amb}) - P_s \cdot R_{th\ j\text{-}a}}{Z_{th\ j\text{-}a}}$$

If $P_s = 0.9$ W, $Z_{th\ j\text{-}a} = 9.2$ °C/W

$$P_{m\ max} = \frac{(150-60) - (0.9 \times 85)}{9.2} = 1.47\ \text{W}$$

therefore, the total repetitive peak power dissipation,

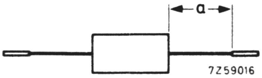
$$P_{ZRM} = 0.9 + 1.47 = 2.37\ \text{W}$$

From page 11, lower figure, the corresponding repetitive peak zener current is 65 mA. This is within the rating of the BZX70-C30 and is therefore permissible.

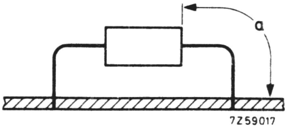
THERMAL RESISTANCE

Effect of mounting on thermal resistance $R_{th\ j-a}$

The quoted values apply when no other leads run to the tie–points. If leads of other dissipating components share the same tie–points, the thermal resistance will be higher than that quoted.

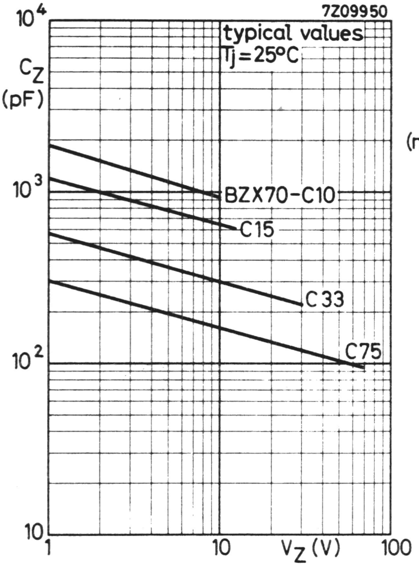


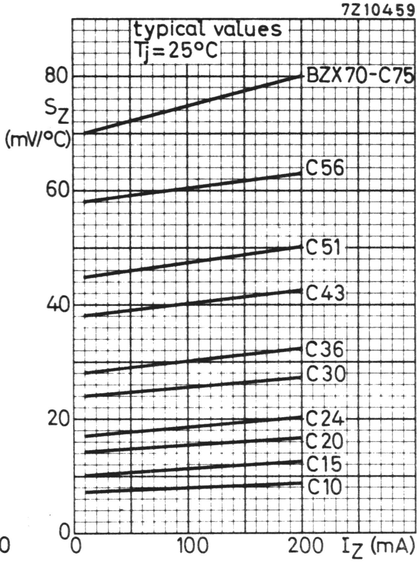
1. Mounted to solder tags at a lead-length a = 10 mm. $R_{th\ j-a}$ = 60 °C/W
2. Mounted to solder tags at a = maximum lead-length. $R_{th\ j-a}$ = 70 °C/W

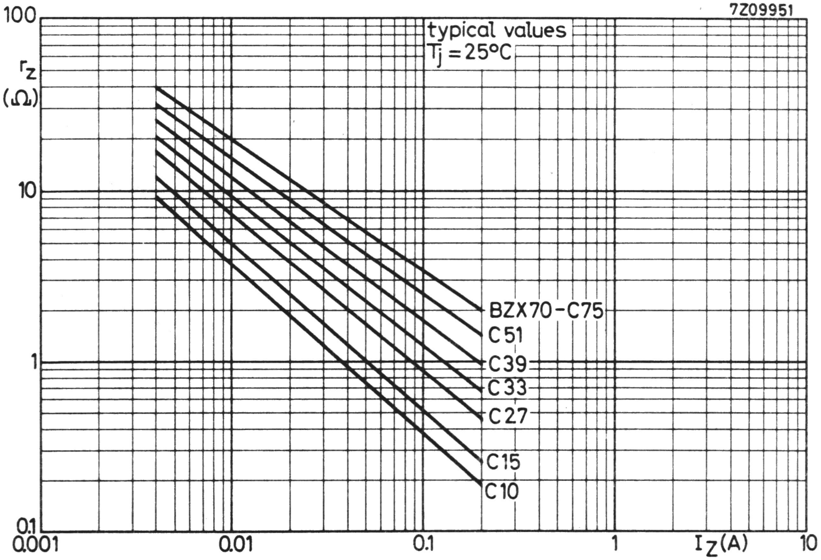


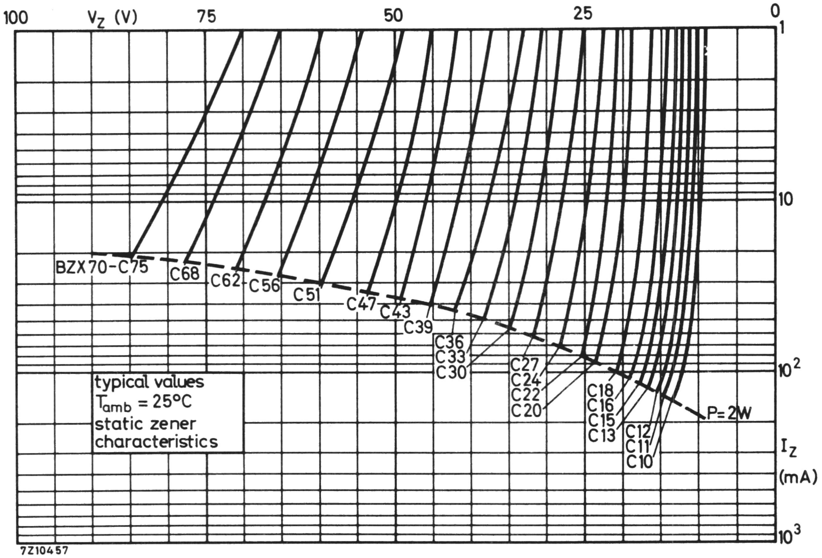
3. Mounted on printed-wiring board at a = maximum lead-length. $R_{th\ j-a}$ = 85 °C/W
4. Mounted on printed-wiring board at a lead-length a = 10 mm. $R_{th\ j-a}$ = 95 °C/W

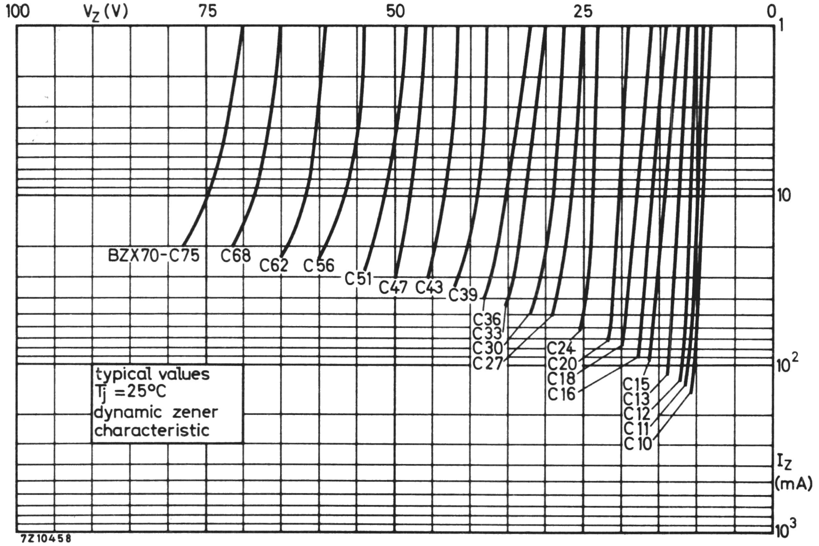
1. Soldered joints must be at least 5 mm from the seal.
2. The maximum permissible temperature of the soldering iron or bath is 300 °C; it must be in contact with the joint for no more than 3 seconds.
3. Avoid hot spots due to handling or mounting; the body of the device must not come into contact with or be exposed to a temperature higher than 150 °C.

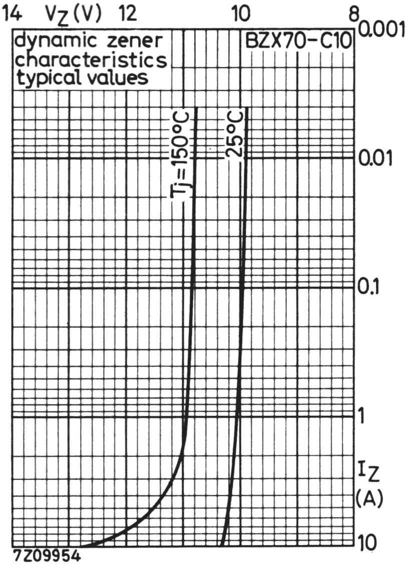

7Z09950
typical values
Tj = 25°C
C_Z
(pF)
10^4
10^3
10^2
10
1
10
V_Z (V)
100
BZX70-C10
C15
C33
C75

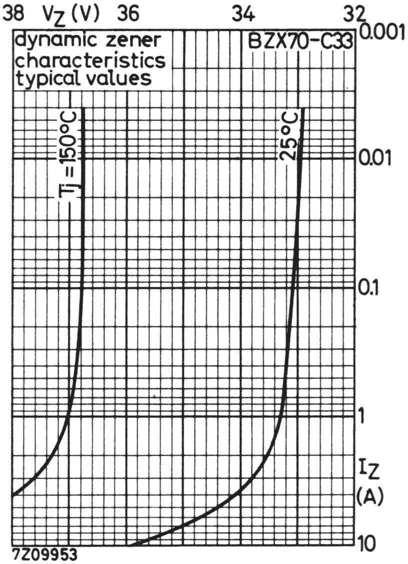

7Z10459
typical values
Tj = 25°C
S_Z
(mV/°C)
80
60
40
20
0
0
100
200
I_Z (mA)
BZX70-C75
C56
C51
C43
C36
C30
C24
C20
C15
C10

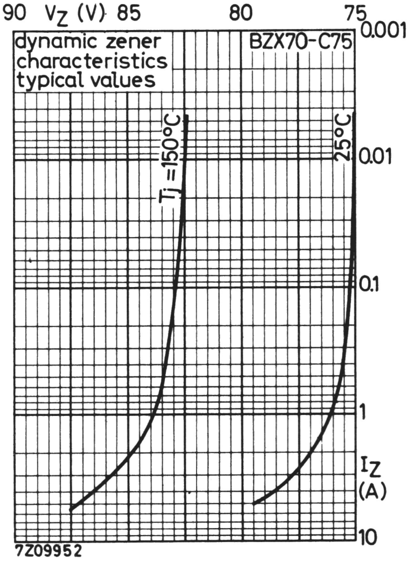

7Z09951
typical values
Tj = 25°C
r_Z
(Ω)
100
10
1
0.1
0.001
0.01
0.1
1
I_Z(A)
10
BZX70-C75
C51
C39
C33
C27
C15
C10

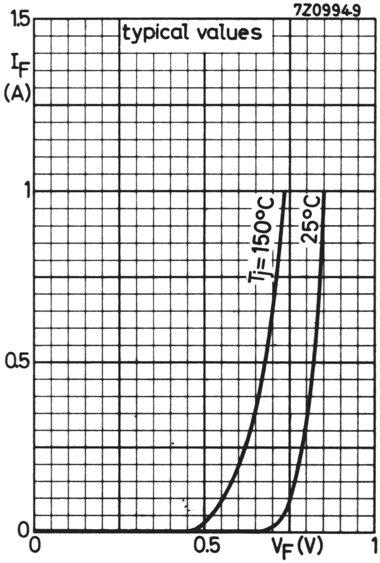

100
V_Z (V)
75
50
25
0
1
10
10^2
10^3
I_Z
(mA)
BZX70-C75
C68
C62
C56
C51
C47
C43
C39
C36
C33
C30
C27
C24
C22
C20
C18
C16
C15
C13
C12
C11
C10
P=2W
typical values
T_{amb} = 25°C
static zener characteristics
7Z10457

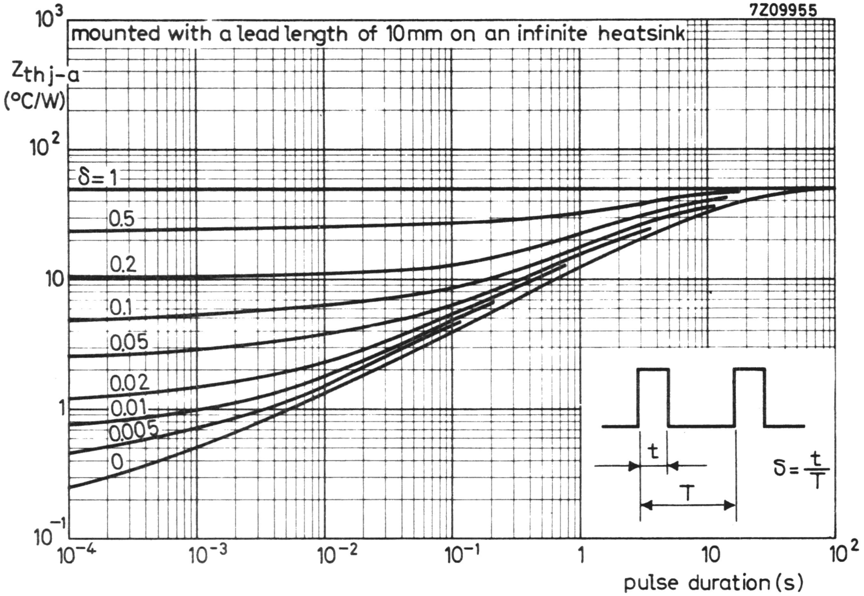

100
V_Z (V)
75
50
25
0
1
10
10^2
10^3
I_Z
(mA)
BZX70-C75
C68
C62
C56
C51
C47
C43
C39
C36
C33
C30
C27
C24
C20
C18
C16
C15
C13
C12
C11
C10
typical values
T_j = 25°C
dynamic zener characteristic
7Z10458

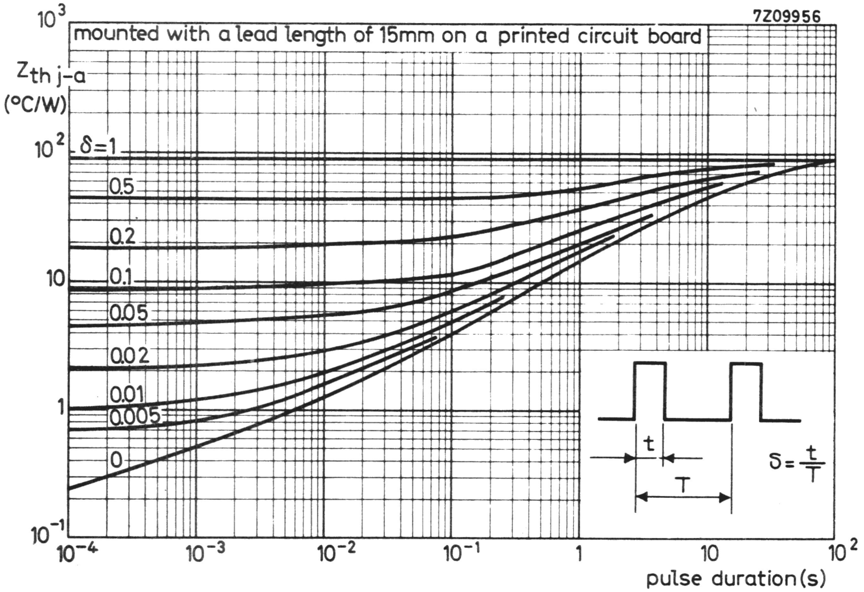

14 VZ (V) 12 10 8
dynamic zener characteristics typical values
BZX70-C10
Tj=150°C
25°C
0.001
0.01
0.1
1
IZ (A)
10
7Z09954

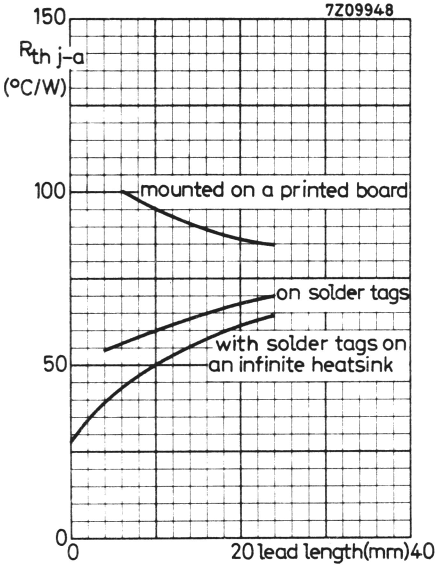

38 VZ (V) 36 34 32
dynamic zener characteristics typical values
BZX70-C33
Tj=150°C
25°C
0.001
0.01
0.1
1
IZ (A)
10
7Z09953

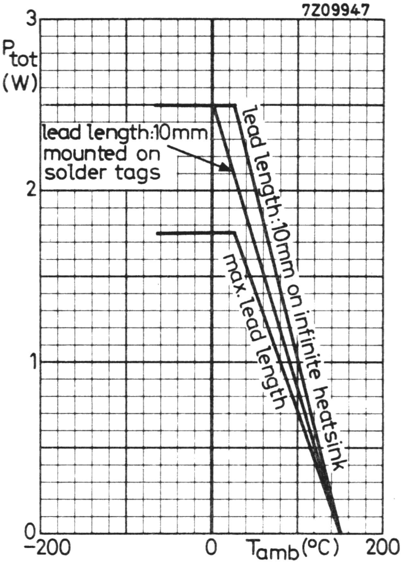

90 VZ (V) 85 80 75
dynamic zener characteristics typical values
BZX70-C75
Tj=150°C
25°C
0.001
0.01
0.1
1
IZ (A)
10
7Z09952

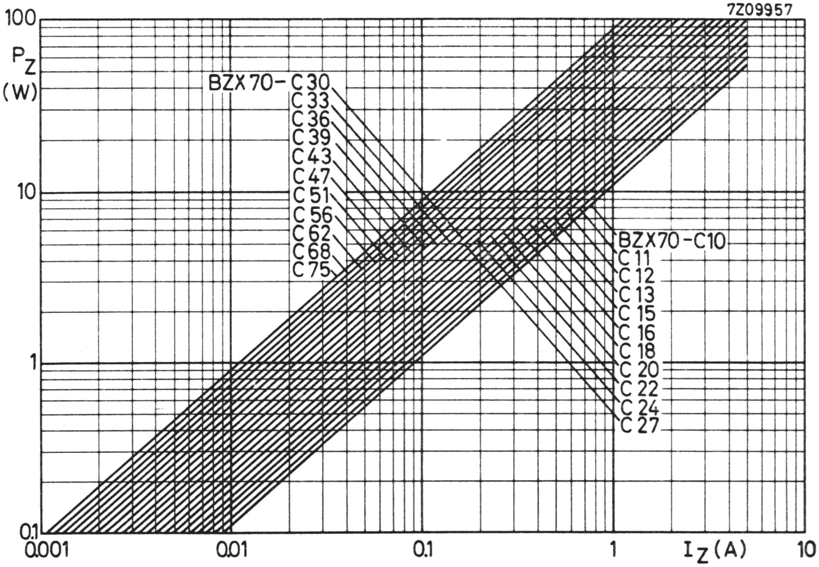

7Z09949
typical values
1.5
IF (A)
1
0.5
0
0
0.5
VF (V)
1
Tj=150°C
25°C


7Z09955
mounted with a lead length of 10mm on an infinite heatsink
Z th j-a (°C/W)
10^3
10^2
10
1
10^-1
δ = 1
0.5
0.2
0.1
0.05
0.02
0.01
0.005
0
10^-4
10^-3
10^-2
10^-1
1
10
10^2
pulse duration (s)
t
T
δ = t/T


7Z09956
mounted with a lead length of 15mm on a printed circuit board
Z th j-a (°C/W)
10^3
10^2
10
1
10^-1
δ = 1
0.5
0.2
0.1
0.05
0.02
0.01
0.005
0
10^-4
10^-3
10^-2
10^-1
1
10
10^2
pulse duration (s)
t
T
δ = t/T


7Z09948
150
$R_{th\ j-a}$
(°C/W)
100
mounted on a printed board
on solder tags
with solder tags on
an infinite heatsink
50
0
0
20 lead length(mm)40


7Z09947
3
P_{tot}
(W)
lead length:10mm
mounted on
solder tags
lead length:10mm on infinite heatsink
max. lead length
2
1
0
−200
0
T_{amb}(°C)
200


7Z09957
100
P_Z
(W)
BZX70-C30
C33
C36
C39
C43
C47
C51
C56
C62
C68
C75
BZX70-C10
C11
C12
C13
C15
C16
C18
C20
C22
C24
C27
10
1
0.1
0.001
0.01
0.1
1
I_Z (A)
10

STABISTORS

Diodes with controlled conductance in a subminiature DO-7 envelope intended for low voltage regulation in circuits for clipping, coupling, clamping, meter protection, bias regulation and in many applications which require tight tolerances and low voltage levels.
The series consists of 4 types with nominal zener voltages ranging from 1.4 to 3.6 V with a tolerance of ± 5%.

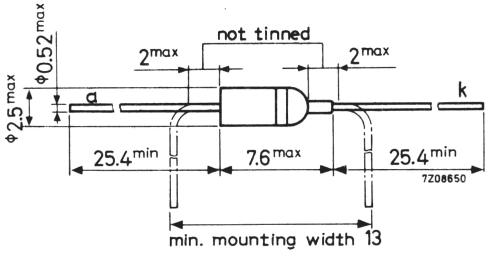
QUICK REFERENCE DATA

Regulation voltage (forward voltage)	V_F	nom.	1.4 to 3.6	V
Regulation voltage tolerance			± 5	%
Reverse voltage (d.c.)	V_R	max.	10	V
(repetitive peak)	V_{RRM}	max.	10	V
Repetitive peak forward current	I_{FRM}	max.	250	mA
Total power dissipation up to $T_{amb} = 35\ ^{o}C$	P_{tot}	max.	400	mW
Junction temperature	T_j	max.	175	^{o}C

MECHANICAL DATA

Dimensions in mm

DO-7


not tinned
2^{max}
2^{max}
$\phi 0.52^{max}$
$\phi 2.5^{max}$
a
k
25.4^{min}
7.6^{max}
25.4^{min}
7Z08650
min. mounting width 13

The coloured band indicates the cathode

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

Reverse voltage (d.c.)	V_R	max.	10	V
(repetitive peak)	V_{RRM}	max.	10	V

Current

Repetitive peak forward current	I_{FRM}	max.	250	mA

Power dissipation

Total power dissipation up to $T_{amb} = 35\,^oC$	P_{tot}	max.	400	mW

Temperatures

Storage temperature	T_{stg}	-65 to +175		^oC
Junction temperature	T_j	max.	175	^oC

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.35	$^oC/mW$

CHARACTERISTICS

	Regulation voltage V_F (forward voltage) at I_F = 1 mA			Temperature coefficient S_F at I_F = 1 mA	Differential resistance r_d f = 1 kHz at I_F = 1 mA	
BZX75-...	min.		max.	typ.	typ.	
C1V4	1.16		1.34 V	-4 mV/°C	60 Ω	
C2V1	1.75		2.05 V	-6 mV/°C	90 Ω	
C2V8	2.33		2.70 V	-8 mV/°C	120 Ω	
C3V6	3.02		3.45 V	-10 mV/°C	150 Ω	
	at I_F = 10 mA			at I_F = 10 mA	at I_F = 10 mA	
	min.	nom.	max.	typ.	typ.	max.
C1V4	1.33	1.4	1.47 V	-3.3 mV/°C	6	10 Ω
C2V1	1.99	2.1	2.21 V	-5.0 mV/°C	9	15 Ω
C2V8	2.66	2.8	2.94 V	-6.6 mV/°C	12	20 Ω
C3V6	3.12	3.6	3.78 V	-8.2 mV/°C	15	25 Ω

Reverse current

V_R = 5 V

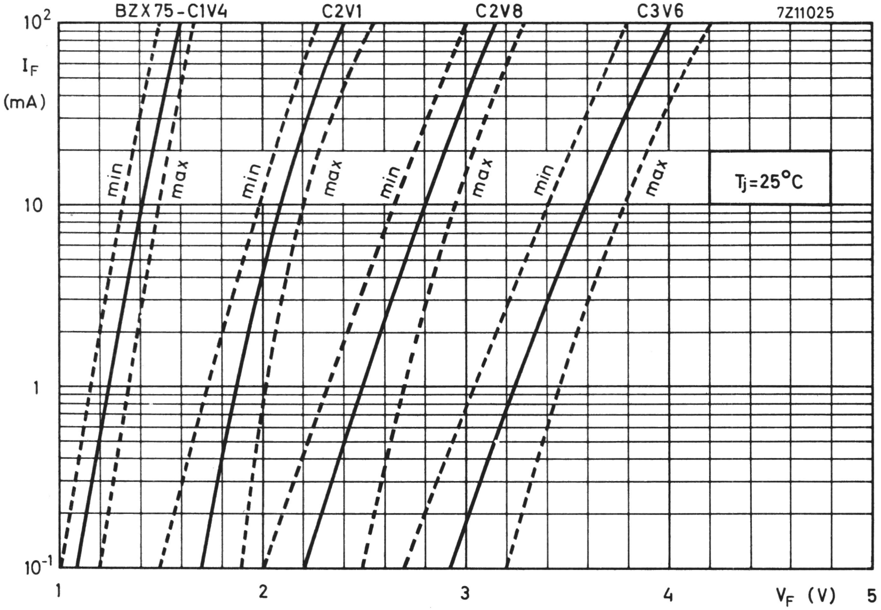
BZX75-C1V4 BZX75-C2V1	I_R	< 500	nA
BZX75-C2V8 BZX75-C3V6	I_R	< 200	nA

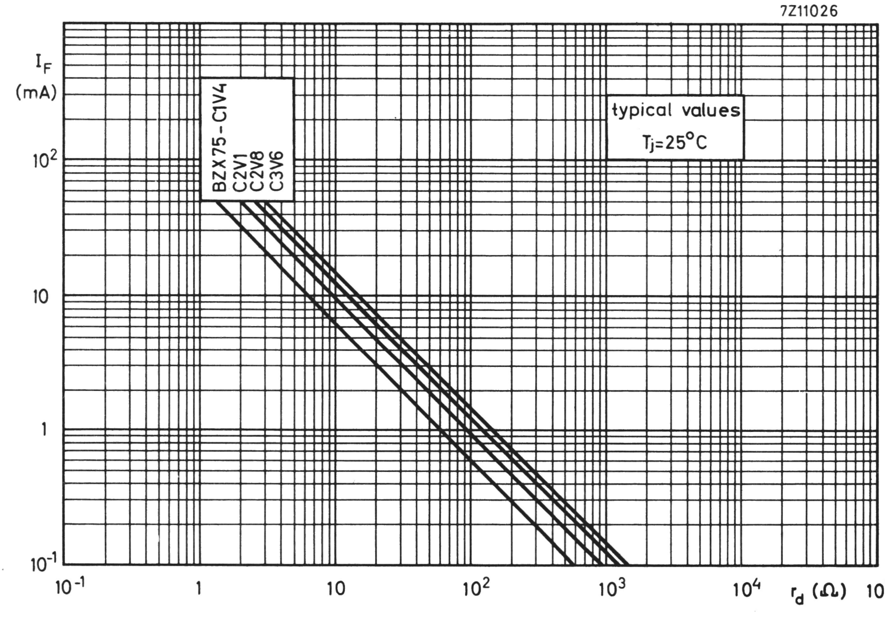
Recovered charge when switched from

I_F = 10 mA to V_R = 5 V; R_L = 500 Ω Q_s > 600 pC

Diode capacitance

V_R = 0; f = 1 MHz C_d < 250 pF


7Z11025
BZX75-C1V4
C2V1
C2V8
C3V6
10^2
I_F
(mA)
10
1
10^{-1}
min
max
min
max
min
max
min
max
$T_j = 25^\circ C$
1
2
3
4
V_F (V)
5


7Z11026
I_F
(mA)
10^2
10
1
10^{-1}
BZX75-C1V4
C2V1
C2V8
C3V6
typical values
$T_j = 25^\circ C$
10^{-1}
1
10
10^2
10^3
10^4
r_d (Ω)
10^5

VOLTAGE REGULATOR DIODES

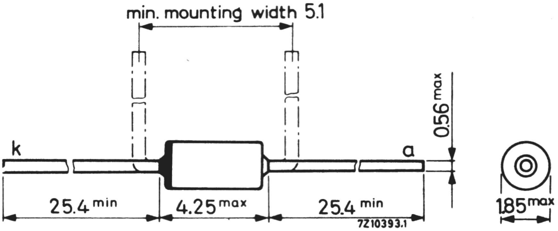
Silicon planar diodes in a DO-35 envelope intended for use as low power voltage stabilizers or voltage references.
Available in two series, one with ± 5 % and the other with ± 2 % tolerance on the zener voltage. Each series consists of 30 types with nominal zener voltages ranging from 4.7 V to 75 V.

QUICK REFERENCE DATA

Zener voltage range		nom.	4.7 to 75	V
Zener voltage tolerance			±5	%
Total power dissipation up to T_{amb} = 50 °C	P_{tot}	max.	400	mW
Non-repetitive peak reverse power	P_{ZSM}	max.	30	W
Junction temperature	T_j	max.	200	°C
Thermal resistance from junction to ambient	$R_{th\ j-a}$	=	0.38	°C/mW

MECHANICAL DATA Dimensions in mm

DO-35



Cathode indicated by coloured mark or by broad band if colour coded (see General Section)

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Currents

Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	250	mA
Repetitive peak forward current	I_{FRM}	max.	250	mA

Power dissipation

Total power dissipation up to T_{amb} = 50 °C	P_{tot}	max.	400	mW
Non-repetitive peak reverse power t = 100 μs; T_j = 150 °C	P_{ZSM}	max.	30	W

Temperatures

Storage temperature	T_{stg}	-65 to +200		°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air at maximum lead length	$R_{th\ j\text{-}a}$	=	0.38	°C/mW

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Forward voltage

I_F = 10 mA; T_{amb} = 25 °C	V_F	<	0.9	V

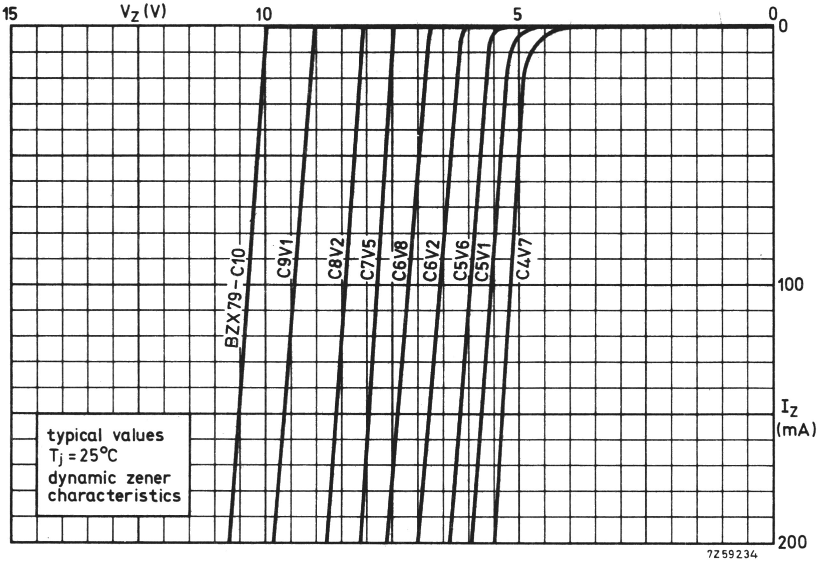
Reverse current

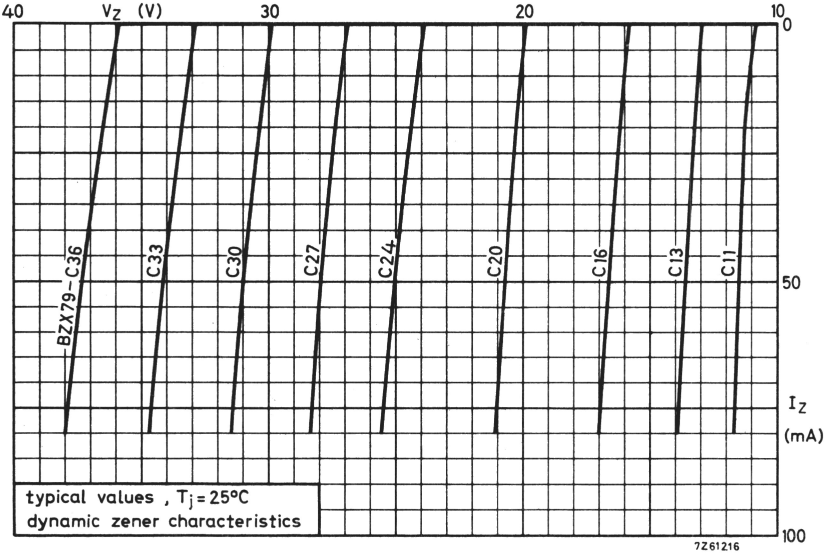
BZX79-.4V7	V_R = 2 V	I_R	<	3000	nA
.5V1	V_R = 2 V	I_R	<	2000	nA
.5V6	V_R = 2 V	I_R	<	1000	nA
.6V2	V_R = 4 V	I_R	<	3000	nA
.6V8	V_R = 4 V	I_R	<	2000	nA
.7V5	V_R = 5 V	I_R	<	1000	nA
.8V2	V_R = 5 V	I_R	<	700	nA
.9V1	V_R = 6 V	I_R	<	500	nA
.10	V_R = 7 V	I_R	<	200	nA
.11 to .13	V_R = 8 V	I_R	<	100	nA
.15 to .75	V_R = 0.7 V_{Znom}	I_R	<	50	nA

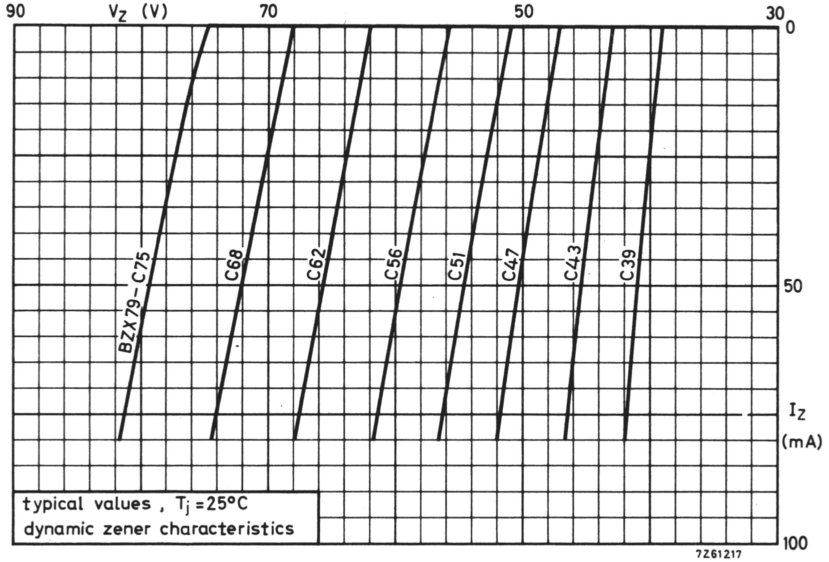
. = B for 2% tolerance
. = C for 5% tolerance

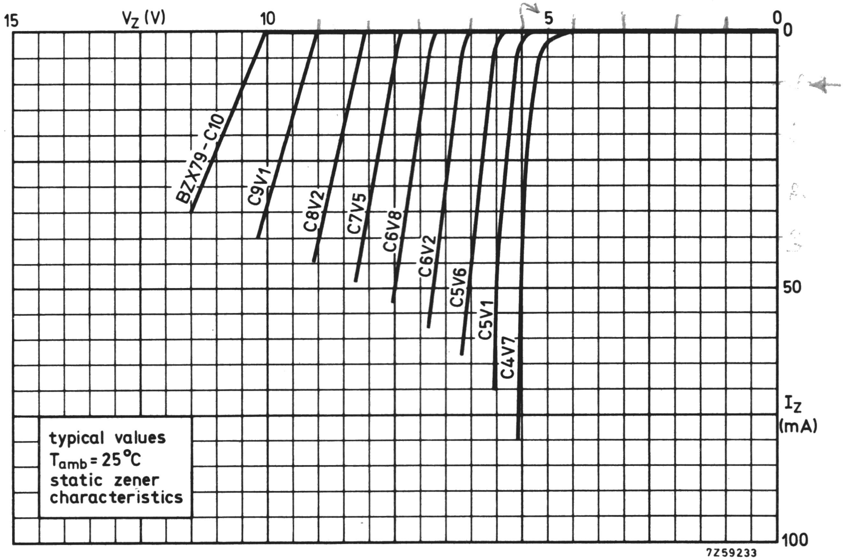
CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

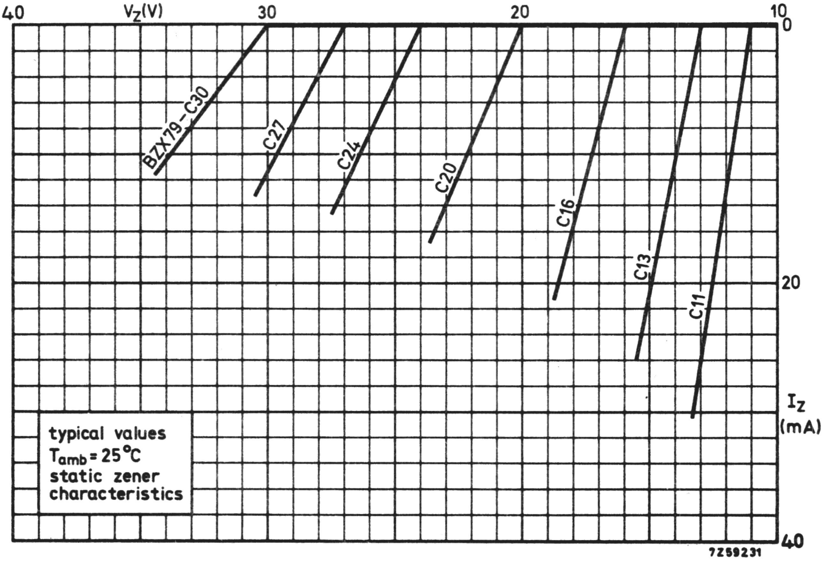
BZX79-...	Zener voltage V_Z at I_Z = 5 mA	Temperature coefficient S_Z at I_Z = 5 mA	Differential resistance r_Z at I_Z = 5 mA f = 1 kHz	Diode capacitance C_d at f = 1 MHz; V_R = 0	
	nom.	typ.	max.	typ.	max.
.4V7	4.7 V	− 1.4 mV/°C	80 Ω	130	180 pF
.5V1	5.1 V	− 0.8 mV/°C	60 Ω	110	160 pF
.5V6	5.6 V	+ 1.2 mV/°C	40 Ω	95	140 pF
.6V2	6.2 V	+ 2.3 mV/°C	10 Ω	90	130 pF
.6V8	6.8 V	+ 3.0 mV/°C	15 Ω	85	110 pF
.7V5	7.5 V	+ 4.0 mV/°C	15 Ω	80	100 pF
.8V2	8.2 V	+ 5.0 mV/°C	15 Ω	75	95 pF
.9V1	9.1 V	+ 6.0 mV/°C	15 Ω	70	90 pF
.10	10 V	+ 7.0 mV/°C	20 Ω	70	90 pF
.11	11 V	+ 8.0 mV/°C	20 Ω	65	85 pF
.12	12 V	+ 9.0 mV/°C	25 Ω	65	85 pF
.13	13 V	+10.5 mV/°C	30 Ω	60	80 pF
.15	15 V	+12.5 mV/°C	30 Ω	55	75 pF
.16	16 V	+13.0 mV/°C	40 Ω	52	75 pF
.18	18 V	+15.0 mV/°C	45 Ω	47	70 pF
.20	20 V	+17.0 mV/°C	55 Ω	36	60 pF
.22	22 V	+19.0 mV/°C	55 Ω	34	60 pF
.24	24 V	+21.0 mV/°C	70 Ω	33	55 pF
	at I_Z = 2 mA	at I_Z = 2 mA	at I_Z = 2 mA		
	nom.	typ.	max.	typ.	max.
.27	27 V	+23.5 mV/°C	80 Ω	30	50 pF
.30	30 V	+ 26 mV/°C	80 Ω	27	50 pF
.33	33 V	+ 29 mV/°C	80 Ω	25	45 pF
.36	36 V	+ 31 mV/°C	90 Ω	23	45 pF
.39	39 V	+ 34 mV/°C	130 Ω	21	45 pF
.43	43 V	+ 37 mV/°C	150 Ω	21	40 pF
.47	47 V	+ 40 mV/°C	170 Ω	19	40 pF
.51	51 V	+ 44 mV/°C	180 Ω	19	40 pF
.56	56 V	+ 47 mV/°C	200 Ω	18	40 pF
.62	62 V	+ 51 mV/°C	215 Ω	17	35 pF
.68	68 V	+ 56 mV/°C	240 Ω	17	35 pF
.75	75 V	+ 60 mV/°C	255 Ω	16.5	35 pF

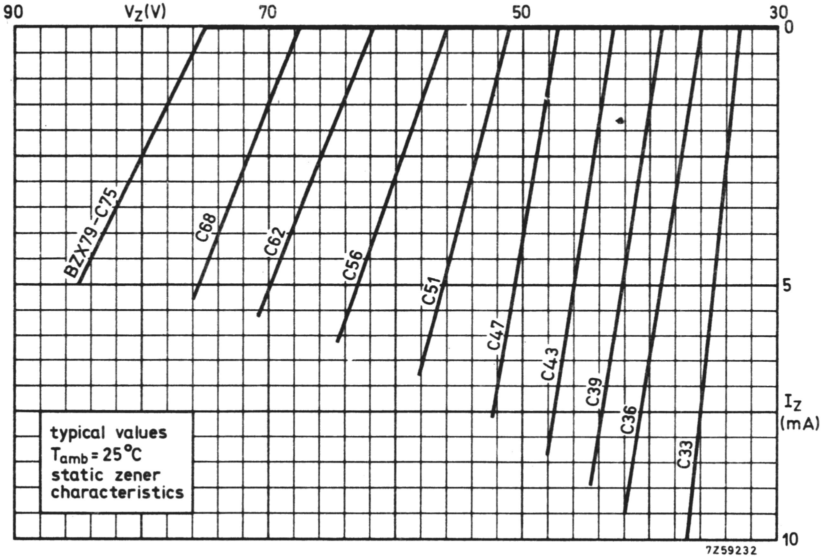

15
V_Z (V)
10
5
0
0
100
200
I_Z (mA)
BZX79–C10
C9V1
C8V2
C7V5
C6V8
C6V2
C5V6
C5V1
C4V7
typical values
T_j = 25°C
dynamic zener
characteristics
7Z59234

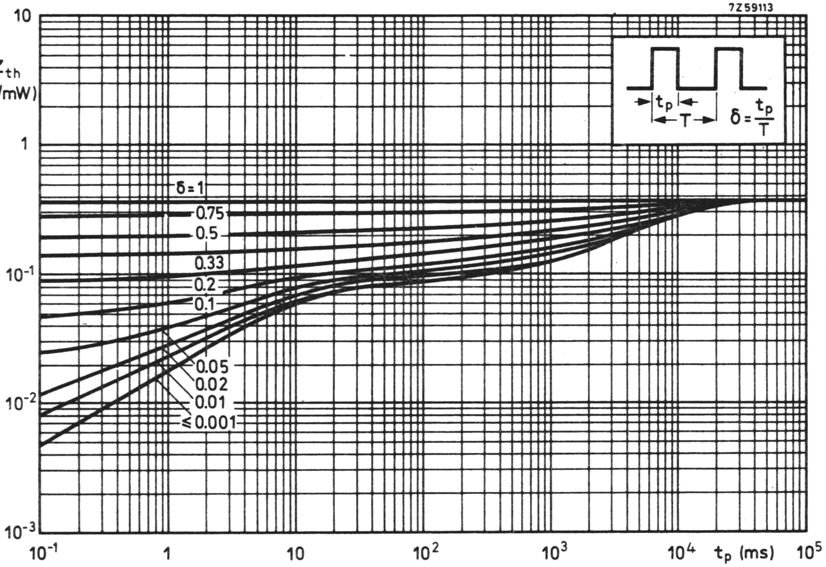

40
V_Z (V)
30
20
10
0
50
100
I_Z (mA)
BZX79–C36
C33
C30
C27
C24
C20
C16
C13
C11
typical values , T_j = 25°C
dynamic zener characteristics
7Z61216

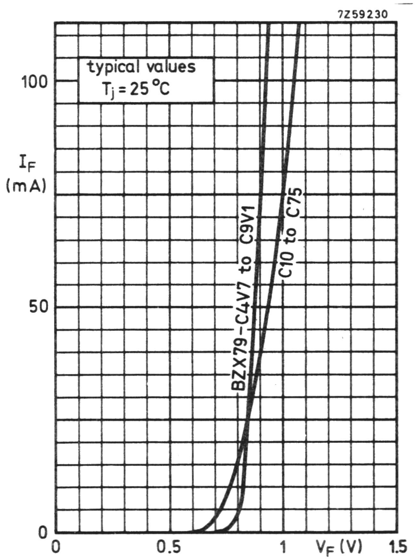

90
V_Z (V)
70
50
30
0
50
100
I_Z (mA)
BZX79-C75
C68
C62
C56
C51
C47
C43
C39
typical values , $T_j = 25°C$
dynamic zener characteristics
7Z61217

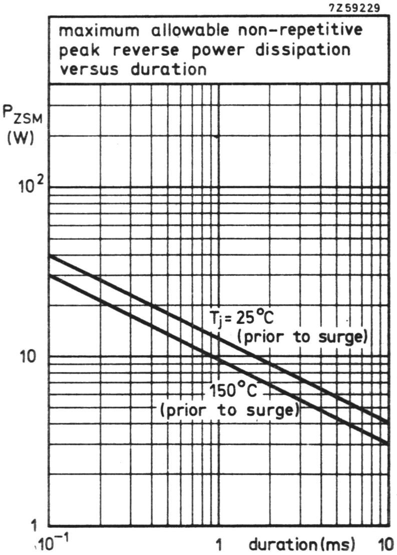

15
V_Z (V)
10
5
0
0
50
100
I_Z (mA)
BZX79-C10
C9V1
C8V2
C7V5
C6V8
C6V2
C5V6
C5V1
C4V7
typical values
$T_{amb} = 25°C$
static zener characteristics
7Z59233

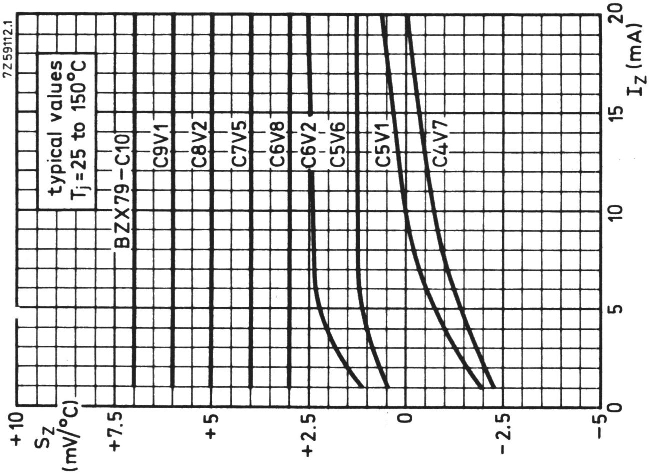

40
V_Z(V)
30
20
10
0
20
40
I_Z (mA)
BZX79-C30
C27
C24
C20
C16
C13
C11
typical values
T_{amb} = 25 °C
static zener characteristics
7Z59231

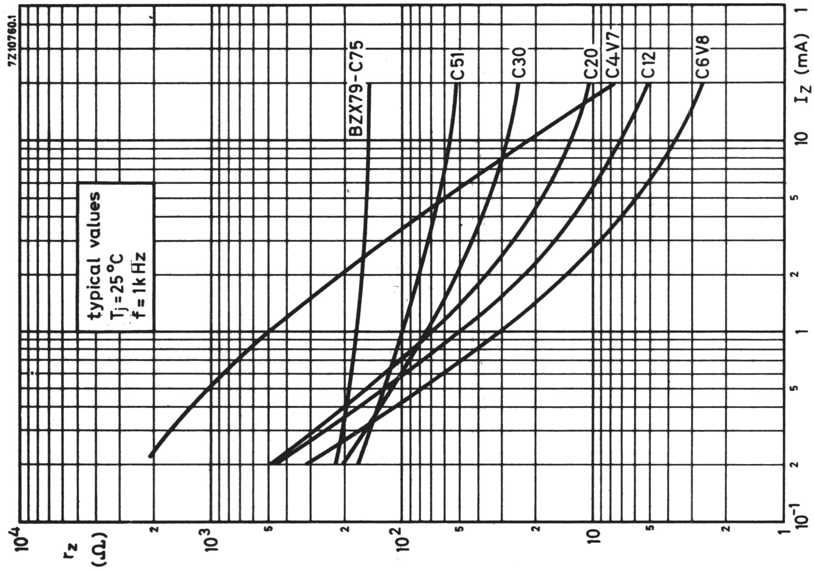

90
V_Z(V)
70
50
30
0
5
10
I_Z (mA)
BZX79-C75
C68
C62
C56
C51
C47
C43
C39
C36
C33
typical values
T_{amb} = 25 °C
static zener characteristics
7Z59232


7Z59113
Z_{th} (°C/mW)
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-1}
1
10
10^2
10^3
10^4
t_p (ms)
10^5
δ = 1
0.75
0.5
0.33
0.2
0.1
0.05
0.02
0.01
≤0.001
t_p
T
$\delta = \frac{t_p}{T}$


7Z59230
typical values
$T_j = 25$ °C
I_F (mA)
100
50
0
0
0.5
1
V_F (V)
1.5
BZX79-C4V7 to C9V1
C10 to C75


7Z59229
maximum allowable non-repetitive peak reverse power dissipation versus duration
P_{ZSM} (W)
10^2
10
1
10^{-1}
1
duration (ms)
10
$T_j = 25$ °C (prior to surge)
150 °C (prior to surge)


7Z59112.1
typical values
T_j = 25 to 150°C
BZX79–C10
C9V1
C8V2
C7V5
C6V8
C6V2
C5V6
C5V1
C4V7
S_Z (mV/°C)
+10
+7.5
+5
+2.5
0
−2.5
−5
I_Z (mA)
0
5
10
15
20


7Z10760.1
typical values
T_j = 25°C
f = 1 kHz
BZX79–C75
C51
C30
C20
C4V7
C12
C6V8
r_z (Ω)
10^4
2
10^3
5
2
10^2
5
2
10
5
2
1
10^{-1}
2
5
1
2
5
10
I_Z (mA)
1

LOW POWER VOLTAGE REGULATORS

These types have been superseded by
the BZX79-C5V1 to BZX79-C9V1

VOLTAGE REFERENCE DIODE

Silicon diode in a DO-7 envelope intended for use as a voltage reference diode in general industrial applications.
The BZY78 has an extremely high voltage stability (±1% at a zener current of 11.5 mA).

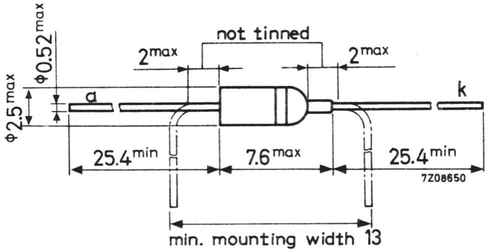
QUICK REFERENCE DATA

Zener voltage at I_Z = 11.5 mA	V_Z	nom.	5.3	V
			5.1 to 5.6	V
Voltage stability at T_{amb} from −50 to 100 °C I_Z = 11.5 mA ±10%	$\frac{\Delta V_Z}{V_Z}$		−1 to +1	%
Repetitive peak zener current	I_{ZRM}	max.	25	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	280	mW
Junction temperature	T_j	max.	150	°C
Thermal resistance	$R_{th\,j\text{-}a}$	=	0.45	°C/mW

MECHANICAL DATA

Dimensions in mm

DO-7


Φ0.52 max
not tinned
2 max
2 max
Φ2.5 max
a
k
25.4 min
7.6 max
25.4 min
7Z08650
min. mounting width 13

The coloured band indicates the cathode

RATINGS (Limiting values) [1]

Currents

Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	50	mA
Repetitive peak forward current	I_{FRM}	max.	50	mA
Zener current (d.c. or average over any 20 ms period)	I_Z	max.	25	mA
Repetitive peak zener current	I_{ZRM}	max.	25	mA

Power dissipation

Total power dissipation up to $T_{amb} = 25\ ^oC$	P_{tot}	max.	280	mW

Temperatures

Storage temperature	T_{stg}		−55 to +150	^oC
Junction temperature	T_j	max.	150	^oC

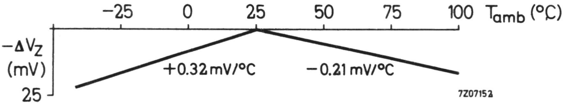
THERMAL RESISTANCE

From junction to ambient	$R_{th\ j\text{-}a}$	=	0.45	^oC/mW

CHARACTERISTICS

$T_j = 25\ ^oC$ unless otherwise specified

Zener voltage at $I_Z = 11.5$ mA	V_Z	nom.	5.3	V
		5.1 to	5.6	V
Forward voltage at $I_F = 1$ mA	V_F	0.65 to	0.75	V
Reverse current at $V_R = 2$ V	I_R	<	1.0	μA
Temperature coefficient $I_Z = 11.5$ mA ±10%; $T_j = -40$ to $+25\ ^oC$	S_Z	typ.	+0.32	mV/^oC
$T_j = +25$ to $+100\ ^oC$	S_Z	typ.	−0.21	mV/^oC



Differential resistance at $I_Z = 11.5$ mA	r_Z	typ.	18	Ω
		15 to	20	Ω
Voltage stability at $T_{amb} = -50$ to $+100\ ^oC$ $I_Z = 11.5$ mA ±10%	$\frac{\Delta V_Z}{V_Z}$	−1 to	+1	%

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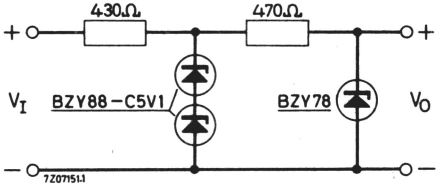
[1] Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

MOUNTING INSTRUCTIONS

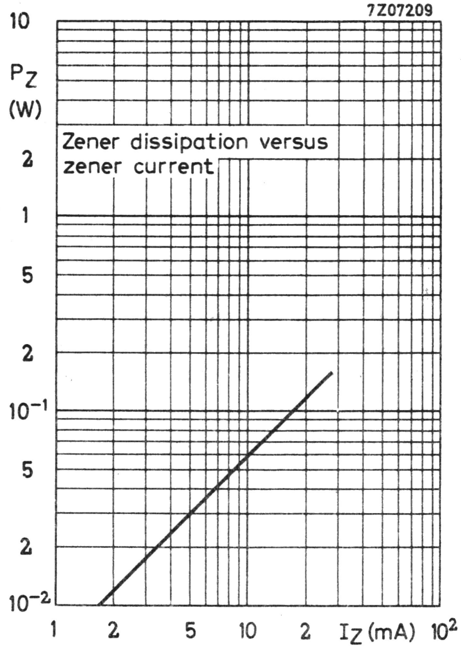
1. When using a soldering iron, the diode may be soldered directly into a circuit, but heat conducted to the junction should be kept to a minimum by use of a thermal shunt.
2. Diodes may be dip soldered at a solder temperature of 245 °C for a maximum soldering time of 5 seconds. The case temperature during dip soldering may exceed the maximum storage temperature for a period not greater than 2 minutes, provided that it at no time exceeds 115 °C. These recommendations apply to a diode with the anode end mounted flush on the board with punched-through holes or spaced at least 1.5 mm above a board with plated-through holes. For mounting the cathode end onto the board the diode must be spaced at least 5 mm from the underside of the printed circuit board in the case of punched-through holes or 5 mm from the top of the board for plated-through holes.
3. Care should be taken not to bend the leads nearer than 1.5 mm from the seals.

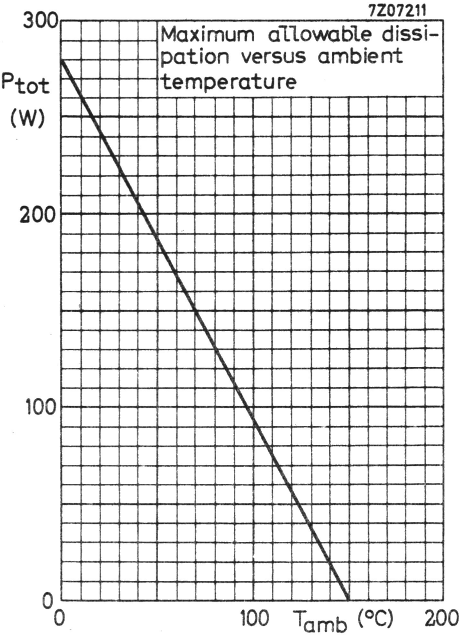
APPLICATION INFORMATION

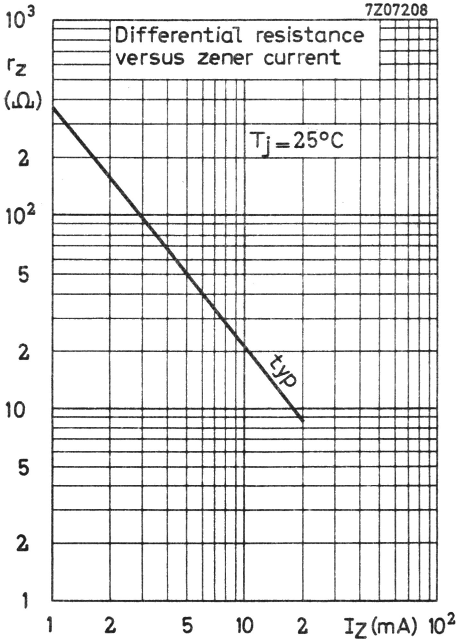
Typical reference-voltage circuit

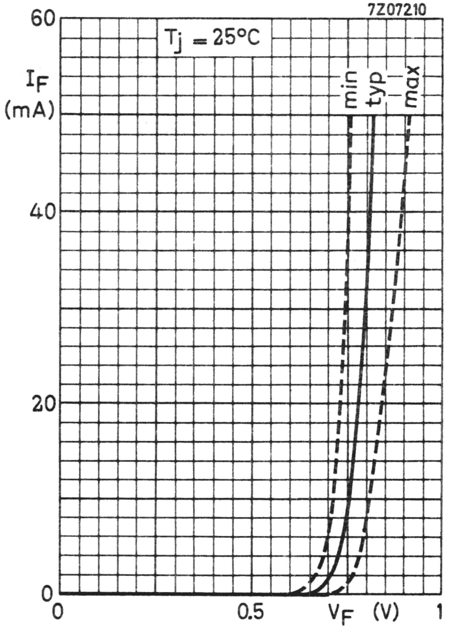


Temperature range	T_{amb}	0 to +50 °C	
Input voltage	V_I	24 V	± 10%
Output voltage	V_O	5.1 to 5.6 V	±0.3%


Zener dissipation versus zener current


Maximum allowable dissipation versus ambient temperature


Differential resistance versus zener current



VOLTAGE REGULATOR DIODES

Silicon diodes in subminiature all glass DO-7 envelope for use as low current voltage stabilizers or voltage references.
The series consists of 24 types with nominal zener voltages ranging from 3.3 V to 30 V with a tolerance of ±5%.

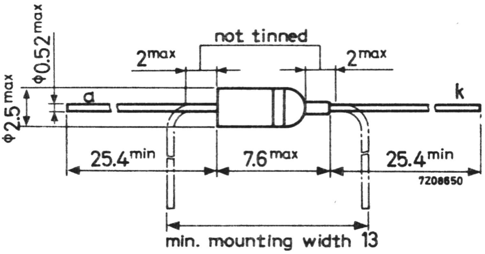
QUICK REFERENCE DATA

Zener voltage range		nom.	3.3 to 30	V
Zener voltage tolerance			±5	%
Repetitive peak zener current	I_{ZRM}	max.	250	mA
Total power dissipation up to $T_{amb} = 50\,^{o}C$	P_{tot}	max.	400	mW
Non repetitive peak reverse power $T_j = 150\,^{o}C$; $t = 100\,\mu s$	P_{ZSM}	max.	15	W
Junction temperature	T_j	max.	175	^{o}C
Thermal resistance from junction to ambient in free air	$R_{th\,j\text{-}a}$	=	0.31	$^{o}C/mW$

MECHANICAL DATA

Dimensions in mm

DO-7


φ0.52max
φ2.5max
not tinned
2max
2max
a
k
25.4min
7.6max
25.4min
7Z08650
min. mounting width 13

The band indicates the cathode side

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Currents

Forward current (d.c.)	I_F	max.	250	mA
Repetitive peak forward current	I_{FRM}	max.	250	mA
Repetitive peak zener current	I_{ZRM}	max.	250	mA

Power dissipation

Total power dissipation up to $T_{amb} = 50\ ^oC$	P_{tot}	max.	400	mW
Non repetitive peak reverse power $T_j = 150\ ^oC$; $t = 100\ \mu s$	P_{ZSM}	max.	15	W

Temperatures

Storage temperature	T_{stg}		−65 to +175	^oC
Junction temperature	T_j	max.	175	^oC

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.31	$^oC/mW$

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Forward voltage

I_F = 10 mA 1)	V_F	<	0.9 V

BZY88-...	Zener voltage V_Z at I_Z = 1 mA				Temperature coefficient S_Z at I_Z = 1 mA				Differential resistance r_Z at I_Z = 1 mA			
	min.	nom.	max.		min.	typ.	max.		min.	typ.	max.	
C3V3	2.4	2.75	3.0	V	−4.5	−1.9	−0.5	mV/°C	380	410	440	Ω
C3V6	2.7	3.0	3.3	V	−4.5	−2.05	−0.5	mV/°C	380	410	430	Ω
C3V9	3.0	3.3	3.6	V	−3.5	−2.4	−0.5	mV/°C	380	410	430	Ω
C4V3	3.3	3.6	3.9	V	−2.7	−2.25	−0.5	mV/°C	340	410	430	Ω
C4V7	3.7	4.1	4.3	V	−2.5	−2.0	−0.3	mV/°C	360	390	420	Ω
C5V1	4.3	4.65	5.0	V	−2.1	−1.9	−0.3	mV/°C	300	340	370	Ω
C5V6	4.8	5.3	5.7	V	−1.8	−1.4	0	mV/°C	160	310	350	Ω
C6V2	5.7	5.9	6.5	V	0	+1.6	+3.0	mV/°C	10	100	250	Ω
C6V8	6.3	6.7	6.9	V	+2	+3.2	+3.7	mV/°C	5.0	15	70	Ω
C7V5	7.0	7.45	7.8	V	+3	+4.2	+5.9	mV/°C	4.0	8.6	20	Ω
C8V2	7.8	8.1	8.5	V	+4.3	+5.0	+6.0	mV/°C	4.0	10	20	Ω
C9V1	8.55	9.0	9.5	V	+4.5	+6.0	+7.0	mV/°C	7.0	12	24	Ω
C10	9.3	9.9	10.5	V	+6.0	+6.6	+7.0	mV/°C	5.0	20	50	Ω
C11	10.3	10.9	11.5	V	+7.1	+8.3	+9.0	mV/°C	5.0	25	70	Ω
C12	11.3	11.9	12.5	V	+7.6	+8.7	+9.2	mV/°C	10	25	80	Ω
C13	12.3	12.9	13.0	V	+9.1	+10.1	+11.1	mV/°C	10	25	90	Ω
C15	13.8	14.9	15.5	V	+11	+12.5	+13	mV/°C	19	35	95	Ω
C16	15.3	15.8	16.9	V	+12	+13	+14	mV/°C	20	45	100	Ω
C18	16.7	17.8	18.9	V	+14	+15	+16.5	mV/°C	20	50	120	Ω
C20	18.7	19.8	21.0	V	+16	+17	+18.5	mV/°C	20	60	140	Ω
C22	20.6	21.8	23.1	V	+17	+19	+21	mV/°C	25	70	150	Ω
C24	22.5	23.8	25.7	V	+19	+21	+23	mV/°C	30	85	200	Ω
C27	24.7	26.6	28.5	V	+21	+22.5	+25	mV/°C	35	90	300	Ω
C30	27.5	29.5	31.5	V	+22	+24	+29	mV/°C	50	180	350	Ω

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1) T_{amb} = 25 °C

CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

BZY88-...	Zener voltage V_Z at I_Z = 5 mA 1)				Temperature coefficient S_Z at I_Z = 5 mA				Differential resistance r_Z at I_Z = 5 mA			
	min.	nom.	max.		min.	typ.	max.		min.	typ.	max.	
C3V3	3.1	3.3	3.5	V	−4.0	−2.3	−0.5	mV/°C	70	83.5	110	Ω
C3V6	3.4	3.6	3.8	V	−3.5	−2.0	−0.5	mV/°C	65	76	105	Ω
C3V9	3.7	3.9	4.1	V	−2.5	−2.05	−0.5	mV/°C	60	76	100	Ω
C4V3	4.0	4.3	4.5	V	−2.5	−1.8	−0.5	mV/°C	55	70	90	Ω
C4V7	4.4	4.7	5.0	V	−2.0	−1.55	0	mV/°C	49	62	85	Ω
C5V1	4.8	5.1	5.4	V	−1.75	−1.2	0	mV/°C	34	46	75	Ω
C5V6	5.3	5.6	6.0	V	−1.5	−0.2	+1.0	mV/°C	10	22	55	Ω
C6V2	5.8	6.2	6.6	V	+0.5	+2.0	+3.5	mV/°C	1.0	7.0	27	Ω
C6V8	6.4	6.8	7.2	V	+2.3	+3.2	+3.8	mV/°C	0.5	3.0	15	Ω
C7V5	7.1	7.5	7.9	V	+3.1	+4.2	+5.9	mV/°C	0.5	3.0	15	Ω
C8V2	7.8	8.2	8.7	V	+4.2	+5.0	+6.0	mV/°C	0.9	3.5	20	Ω
C9V1	8.6	9.1	9.6	V	+4.8	+6.0	+7.0	mV/°C	1.0	4.75	25	Ω
C10	9.4	10	10.6	V	+6.0	+7.0	+7.5	mV/°C	2.0	5.0	25	Ω
C11	10.4	11	11.6	V	+7.0	+8.7	+9.1	mV/°C	3.0	7.0	25	Ω
C12	11.4	12	12.6	V	+8.5	+9.0	+9.6	mV/°C	4.0	8.0	35	Ω
C13	12.4	13	14.1	V	+10	+10.5	+11.5	mV/°C	4.0	10	35	Ω
C15	13.9	15	15.6	V	+12	+12.5	+14	mV/°C	4.0	15	35	Ω
C16	15.4	16	17.1	V	+12	+13	+14	mV/°C	5.0	20	40	Ω
C18	16.9	18	19.1	V	+14	+15	+18	mV/°C	7.0	25	45	Ω
C20	18.9	20	21.2	V	+16	+17	+19	mV/°C	10	30	50	Ω
C22	20.8	22	23.3	V	+17	+19	+21	mV/°C	15	35	60	Ω
C24	22.7	24	25.9	V	+20	+21	+24	mV/°C	20	40	75	Ω
C27	25.1	27	28.9	V	+22	+23.5	+27	mV/°C	25	50	85	Ω
C30	28	30	32	V	+25	+26	+29	mV/°C	30	60	95	Ω

---

1) T_{amb} = 25 °C

CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

BZY88-...	Zener voltage V_Z at I_Z = 20 mA [1]				Temperature coefficient S_Z at I_Z = 20 mA				Differential resistance r_Z at I_Z = 20 mA			
	min.	nom.	max.		min.	typ.	max.		min.	typ.	max.	
C3V3	3.5	4	4.2	V	−3.3	−2.4	−0.5	mV/°C	16.0	19.5	22	Ω
C3V6	3.9	4.2	4.4	V	−2.5	−1.55	−0.5	mV/°C	16	18	20	Ω
C3V9	4.2	4.45	4.65	V	−2.4	−1.55	−0.5	mV/°C	14	16	18	Ω
C4V3	4.45	4.7	4.95	V	−2.0	−1.5	−0.5	mV/°C	13	15	17	Ω
C4V7	4.9	5.1	5.3	V	−1.5	−0.85	0	mV/°C	12	15	17	Ω
C5V1	5.1	5.35	5.7	V	−1.5	−0.8	0	mV/°C	4.0	7.0	11	Ω
C5V6	5.45	5.75	6.1	V	−1.0	+1.0	+3.0	mV/°C	1.5	4.0	8.0	Ω
C6V2	5.95	6.4	6.7	V	+1.0	+2.2	+4.0	mV/°C	0.8	1.4	3.1	Ω
C6V8	6.6	6.9	7.25	V	+2.8	+3.2	+3.8	mV/°C	0.7	1.3	3.0	Ω
C7V5	7.2	7.65	7.95	V	+2.5	+4.2	+5.9	mV/°C	0.5	1.6	5.0	Ω
C8V2	7.9	8.4	8.75	V	+4.0	+5.0	+6.0	mV/°C	0.9	1.8	6.0	Ω
C9V1	8.7	9.4	9.7	V	+5.0	+6.0	+7.0	mV/°C	1.0	1.85	7.0	Ω
C10	9.5	10.1	10.8	V	+7.0	+7.3	+7.5	mV/°C	1.0	2.0	8.0	Ω
C11	10.5	11.1	11.8	V	+8.5	+9.1	+9.5	mV/°C	1.0	3.0	10	Ω
C12	11.6	12.2	12.8	V	+8.9	+9.6	+10.3	mV/°C	2.0	3.5	25	Ω
C13	12.6	13.2	14.3	V	+11	+11.5	+12.5	mV/°C	2.0	4.5	25	Ω
C15	14.1	15.3	15.9	V	+12	+13.5	+14.5	mV/°C	2.0	6.0	25	Ω
C16	15.6	16.3	17.4	V	+13	+14	+15	mV/°C	5.0	10	30	Ω
C18	17.2	18.4	19.6	V	+15	+16	+18	mV/°C	5.0	12	30	Ω
C20	19.3	20.5	21.9	V	+17.5	+18.5	+20.5	mV/°C	5.0	15	35	Ω
C22	21.3	22.6	24.1	V	+19	+20.5	+22.5	mV/°C	10	18	35	Ω
C24	23.3	24.7	26.7	V	+20	+23	+25	mV/°C	10	20	40	Ω
C27	25.8	28.1	30.1	V	+23	+25.5	+28	mV/°C	10	25	45	Ω
C30	29.0	31.3	33.4	V	+25	+28	+32	mV/°C	10	35	50	Ω

---

1) T_{amb} = 25 °C

CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

BZY88-...	Diode capacitance C_d at V_R = 3 V (typ.)	Reverse current I_R at V_R =	typ.	max.
C3V3	395 pF	1 V	0.54	3.0 µA
C3V6	370 pF	1 V	0.25	3.0 µA
C3V9	335 pF	1 V	0.11	3.0 µA
C4V3	270 pF	1 V	0.1	3.0 µA
C4V7	290 pF	2 V	0.25	3.0 µA
C5V1	275 pF	2 V	0.15	1.0 µA
C5V6	260 pF	2 V	0.6	1.0 µA
C6V2	240 pF	2 V	0.1	1.0 µA
C6V8	220 pF	3 V	0.025	1.0 µA
C7V5	190 pF	3 V	15	500 nA
C8V2	150 pF	3 V	11	400 nA
C9V1	140 pF	5 V	8	400 nA
C10	110 pF	7 V	–	2.5 µA
C11	90 pF	7 V	–	2.5 µA
C12	80 pF	8 V	–	2.5 µA
C13	65 pF	9 V	–	2.5 µA
C15	60 pF	10 V	–	2.5 µA
C16	55 pF	10 V	–	2.5 µA
C18	50 pF	13 V	–	2.5 µA
C20	45 pF	14 V	–	2.5 µA
C22	43 pF	15 V	–	2.5 µA
C24	42 pF	17 V	–	2.5 µA
C27	40 pF	19 V	–	2.5 µA
C30	35 pF	21 V	–	2.5 µA

OPERATING NOTES

1. Dissipation and heatsink considerations

a. Steady-state conditions

The maximum allowable steady-state dissipation $P_{s\ max}$ is given by the relationship

$$P_{s\ max} = \frac{T_{j\ max} - T_{amb}}{R_{th\ j\text{-}a}}$$

where $T_{j\ max}$ is the maximum permissible operating junction temperature,
T_{amb} is the ambient temperature,
$R_{th\ j\text{-}a}$ is the total thermal resistance from junction to ambient

b. Pulse conditions (see fig. below)

The maximum allowable additional pulse power $P_{m\ max}$ is given by the formula

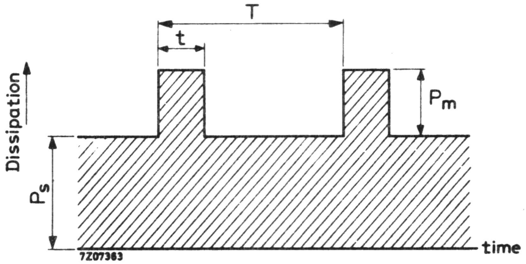
$$P_{m\ max} = \frac{(T_{j max} - T_{amb}) - (P_s \cdot R_{th\ j\text{-}a})}{Z_{th}}$$

where P_s is the steady-state dissipation, excluding that in the pulses,

Z_{th} is the effective transient thermal resistance of the device from junction to ambient. It is a function of the pulse duration t and duty cycle δ (see page 9, lower figure).

δ is the duty cycle and is equal to the pulse duration t divided by the period duration T.

The steady-state power P_s when biased in the zener direction at a given zener current can be found from page 13, upper figure. With the additional pulsed power dissipation $P_{m\ max}$ calculated from the above expression, the total repetitive peak zener power dissipation $P_{ZRM} = P_s + P_{m\ max}$. From page 13, upper figure the corresponding maximum repetitive peak zener current at P_{ZRM} can now be read. This repetitive peak zener current is subject to the absolute maximum rating. For pulse durations longer than the temperature stabilization time of the diode t_{stab}, the maximum allowable repetitive peak dissipation P_{ZRM} is equal to the maximum steady-state power $P_{s\ max}$. The temperature stabilization time for the BZY88 series is 100 s (see page 9, lower figure).



OPERATING NOTES (continued)

Example

The following example illustrates how to calculate the maximum permissible repetitive peak zener current of a BZY88-C7V5 zener diode mounted in free air at a maximum ambient temperature of 60 °C. The steady-state zener current is 10 mA, the duty cycle $\delta = 0.1$ and the pulse duration $t = 1$ ms.

The steady-state dissipation P_S at a zener current of 10 mA (from page 13, upper figure) = 76 mW.
The thermal resistance from junction to ambient $R_{th\ j\text{-}a} = 0.31\ ^{\circ}C/mW$.
The thermal impedance Z_{th} with a duty cycle $\delta = 0.1$ and a pulse duration $t = 1$ ms (from page 9, lower figure).

$$Z_{th} = 41.5\ ^{\circ}C/W$$

The maximum additional pulse power dissipation

$$P_{m\,max} = \frac{(T_{j\,max} - T_{amb}) - P_S \cdot R_{th\ j\text{-}a}}{Z_{th}}$$

If $P_S = 76$ mW, $Z_{th} = 41.5\ ^{\circ}C/W$,

$$P_{m\,max} = \frac{(175-60)-(0.076 \times 310)}{41.5} = 2.2\,W$$

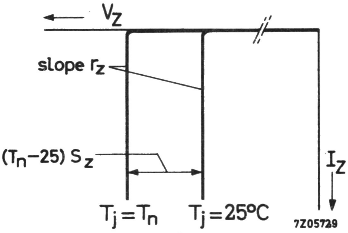
therefore, the total repetitive peak power dissiaption,

$$P_{ZRM} = 0.076 + 2.2 = 2.28\,W$$

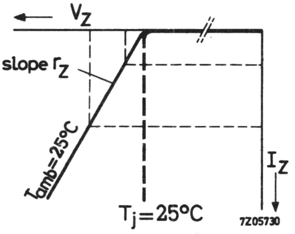
From page 13, upper figure, the corresponding repetitive peak zener current is 250 mA. This is within the rating of the BZY88-C7V5 and is therefore permissible.

2. Zener characteristics

The basic characteristic of a zener diode is the dynamic zener characteristic, that is, the variation of zener voltage when a current pulse is applied in the reverse direction. The slope of this characteristic is r_Z. Typical dynamic characteristics at $T_j = 25$ and 150 °C are given on pages 10 and 11 for each type of diode. Because of the temperature sensitivity of the zener characteristics, the dynamic characteristics at any other operating temperature will be displaced from those at $T_j = 25\ ^{\circ}C$ by a voltage corresponding to $S_Z \times (T_n - 25)\ ^{\circ}C$, where S_Z is the temperature coefficient of the diode and T_n is a nominal operating temperature. This is illustrated below.



Dynamic characteristics



Static characteristic

OPERATING NOTES (continued)

The static characteristic of the diode is obtained by connecting the steady-state zener voltages at various direct zener currents and may, therefore, be used to determine the operating point at any zener current. This is shown above. The slope of the static characteristic will depend on

(1) the differential resistance, r_z

(2) the rise in junction temperature due to internal dissipation and the thermal resistance from junction to ambient, $V_Z . I_Z . R_{th\ j\text{-}a}$

(3) the temperature coefficient of the diode, S_Z

From the above, the static slope resistance r_Z is found to be

$$r_Z = r_z + V_Z . R_{th\ j\text{-}a} . S_Z$$

where r_z is the differential resistance, V_Z is the steady-state zener voltage and is equal to

$$\frac{V_Z'}{1 - I_Z . R_{th\ j\text{-}a} . S_Z}$$

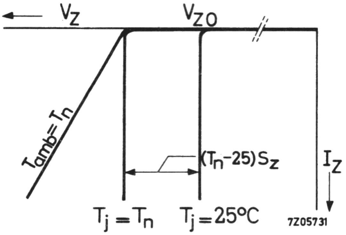
V_Z' being the zener voltage at $T_j = T_n$ at the working current I_Z.

The position of this static characteristic in relation to the dynamic characteristic at T_j = 25 °C is dependent on the ambient temperature and the temperature coefficient, the low-current voltage being displaced by

$$S_Z \times (T_n - 25)\ ^{\circ}C$$

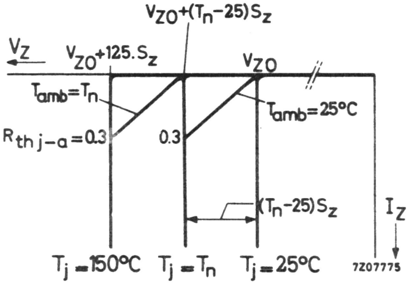
from the low current voltage, V_{ZO} on the dynamic characteristic at T_j = 25 °C (See figure below)

Example for positive S_Z



OPERATING NOTES (continued)

Next figure shows typical dynamic characteristics at T_j = 25, 150 and a nominal temperature, T_n °C. It also shows static characteristics at ambient temperatures of 25 and T_n °C.

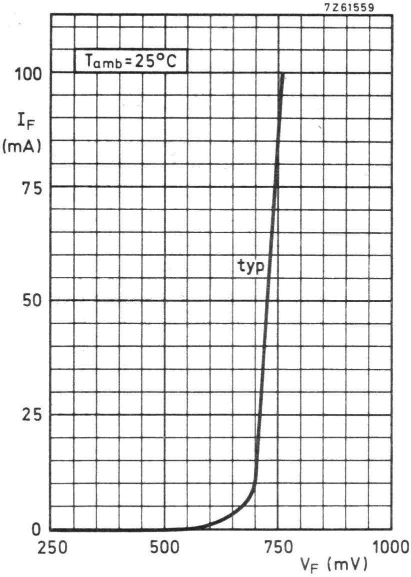


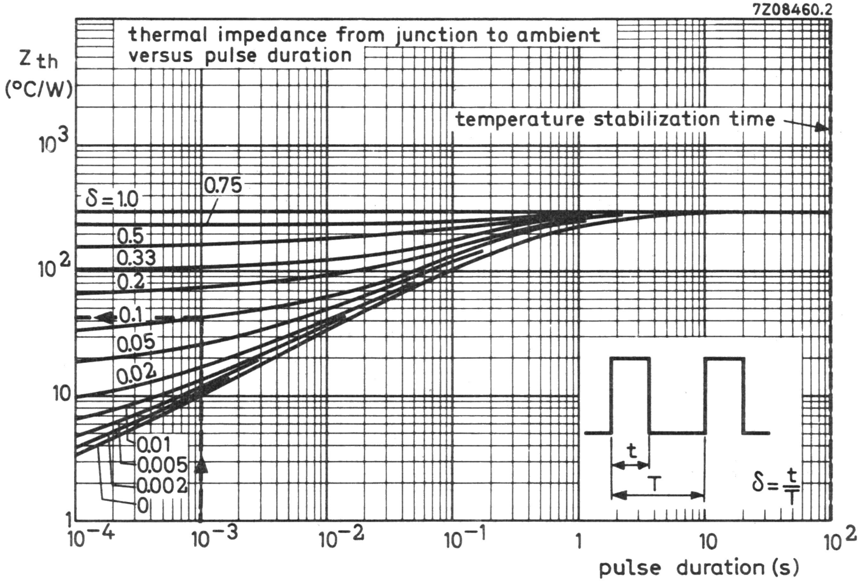
Example for positive S_Z

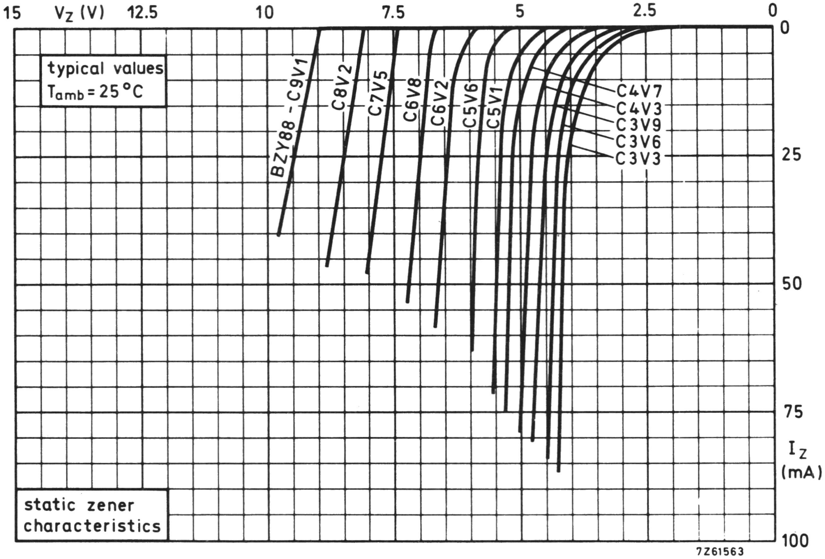
Typical static characteristics for each type of diode are given on page 12. These curves were obtained with the device mounted in free air at an ambient temperature of 25 °C.

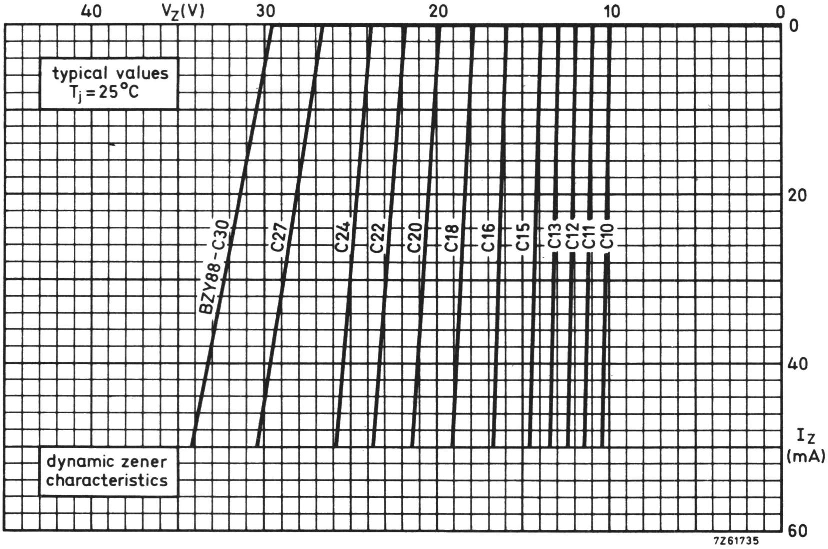
The slope resistance for pulse operation can be calculated by incorporating the thermal impedance Z_{th} into the formula for r_Z. Curves of Z_{th} plotted against pulse duration and duty cycle are given in the lower figure on page 9.

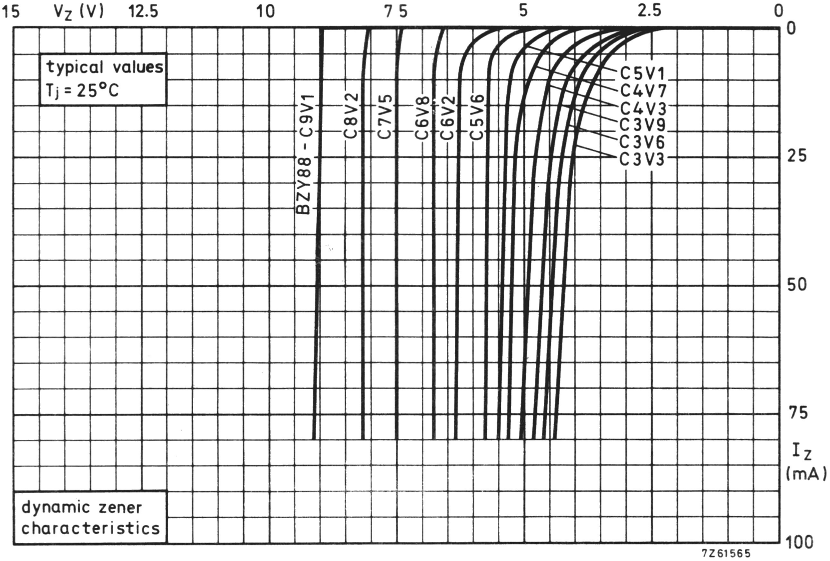
3. When using a soldering iron, the diode may be soldered directly into a circuit, but heat conducted to the junction should be kept to a minimum by use of a thermal shunt.
4. Diodes may be dip soldered at a solder temperature of 245 °C for a maximum soldering time of 5 seconds. The case temperature during dip soldering must not at any time exceed the maximum storage temperature. These recommendations apply to a diode with the anode end mounted flush on the board with punched-through holes. For mounting the cathode end onto the board the diode must be spaced 5 mm from the underside of the printed circuit board in the case of punched-through holes or 5 mm from the top of the board for plated-through holes.
5. Care should be taken not to bend the leads nearer than 1.5 mm from the seals.

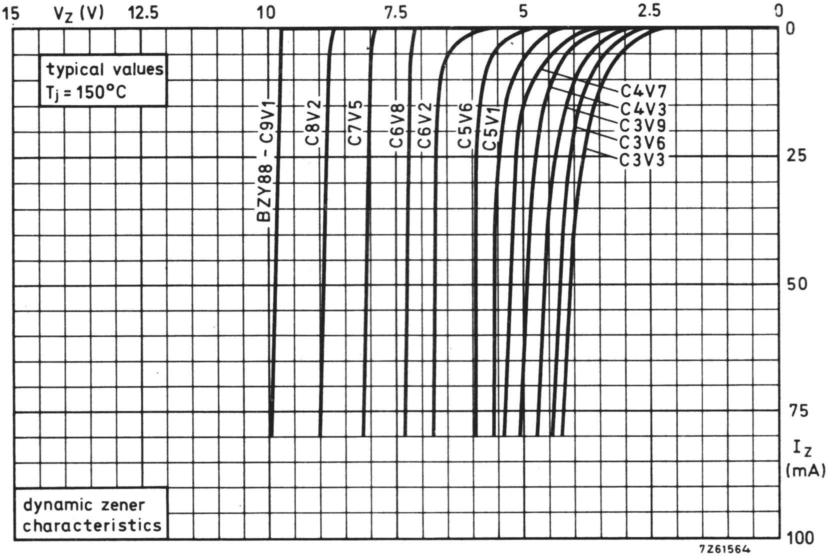

7Z61559
T_{amb} = 25°C
I_F (mA)
100
75
50
25
0
typ
250
500
750
1000
V_F (mV)

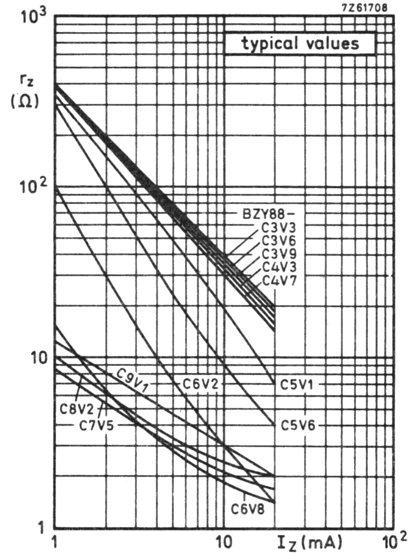

7Z08460.2
thermal impedance from junction to ambient versus pulse duration
Zth (°C/W)
10^3
10^2
10
1
temperature stabilization time
δ = 1.0
0.75
0.5
0.33
0.2
0.1
0.05
0.02
0.01
0.005
0.002
0
t
T
δ = t/T
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
pulse duration (s)

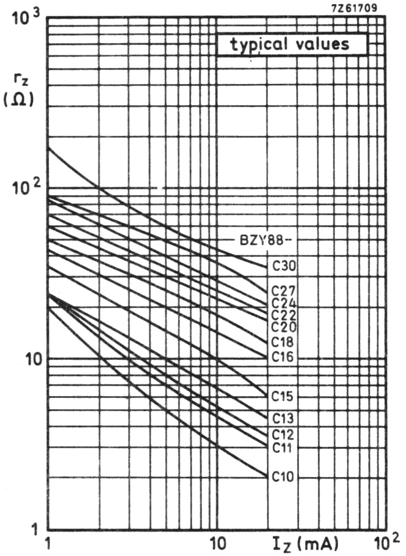

15
V_Z (V)
12.5
10
7.5
5
2.5
0
typical values
T_{amb} = 25 °C
BZY88 - C9V1
C8V2
C7V5
C6V8
C6V2
C5V6
C5V1
C4V7
C4V3
C3V9
C3V6
C3V3
0
25
50
75
I_Z (mA)
100
static zener characteristics
7Z61563

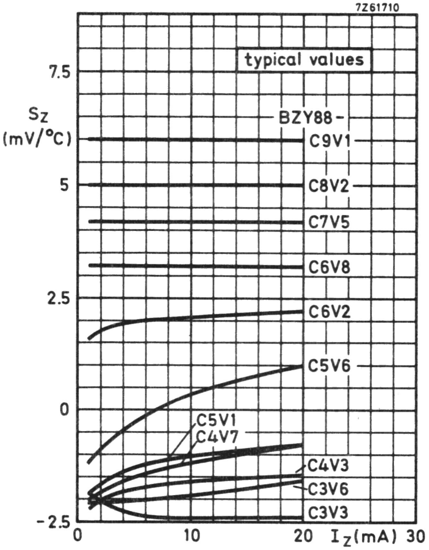

40
V_Z(V)
30
20
10
0
typical values
T_j = 25°C
BZY88-C30
C27
C24
C22
C20
C18
C16
C15
C13
C12
C11
C10
0
20
40
I_Z (mA)
60
dynamic zener characteristics
7Z61735

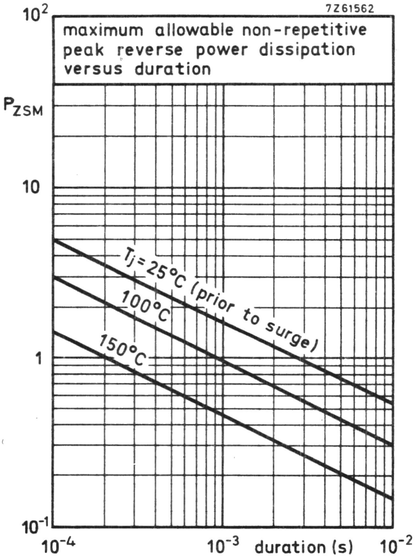

15
VZ (V)
12.5
10
7.5
5
2.5
0
typical values
Tj = 25°C
BZY88 - C9V1
C8V2
C7V5
C6V8
C6V2
C5V6
C5V1
C4V7
C4V3
C3V9
C3V6
C3V3
0
25
50
75
IZ (mA)
100
dynamic zener characteristics
7Z61565

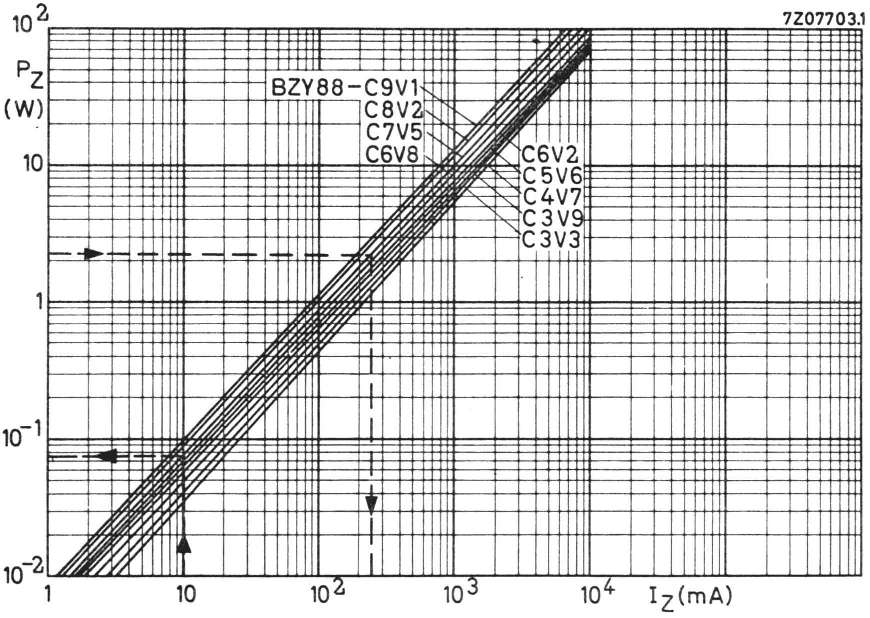

15
VZ (V)
12.5
10
7.5
5
2.5
0
typical values
Tj = 150°C
BZY88 - C9V1
C8V2
C7V5
C6V8
C6V2
C5V6
C5V1
C4V7
C4V3
C3V9
C3V6
C3V3
0
25
50
75
IZ (mA)
100
dynamic zener characteristics
7Z61564

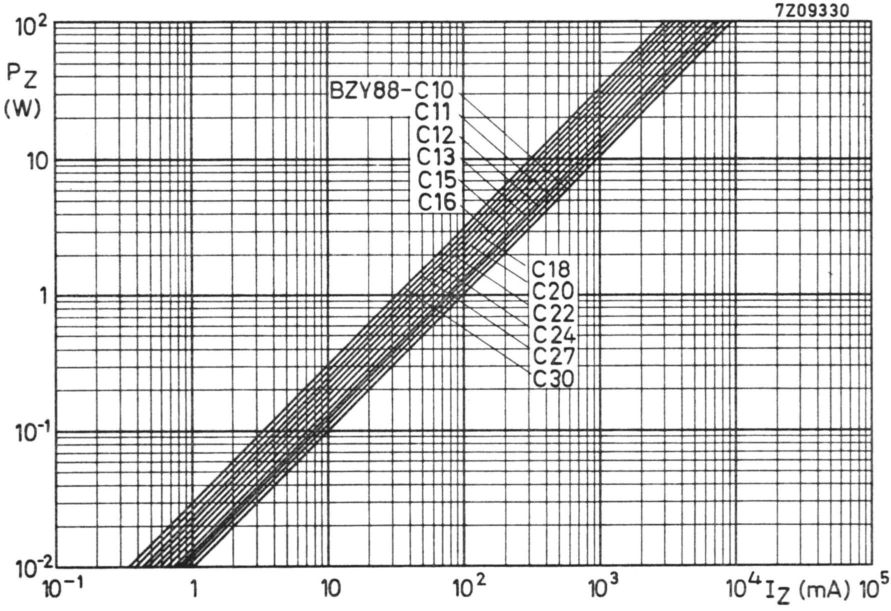

7Z61708
typical values
r_z (Ω)
10^3
10^2
10
1
BZY88-
C3V3
C3V6
C3V9
C4V3
C4V7
C9V1
C6V2
C5V1
C8V2
C7V5
C5V6
C6V8
1
10
I_Z (mA)
10^2


7Z61709
typical values
r_z (Ω)
10^3
10^2
10
1
BZY88-
C30
C27
C24
C22
C20
C18
C16
C15
C13
C12
C11
C10
1
10
I_Z (mA)
10^2


7Z61710
typical values
S_Z (mV/°C)
7.5
5
2.5
0
-2.5
BZY88-
C9V1
C8V2
C7V5
C6V8
C6V2
C5V6
C5V1
C4V7
C4V3
C3V6
C3V3
0
10
20
I_Z(mA)
30


7Z61562
maximum allowable non-repetitive peak reverse power dissipation versus duration
P_{ZSM}
10^2
10
1
10^{-1}
T_j = 25°C (prior to surge)
100°C
150°C
10^{-4}
10^{-3}
duration (s)
10^{-2}


7Z07703.1
P_Z
(W)
10^2
10
1
10^{-1}
10^{-2}
1
10
10^2
10^3
10^4
I_Z(mA)
BZY88-C9V1
C8V2
C7V5
C6V8
C6V2
C5V6
C4V7
C3V9
C3V3


7Z09330
P_Z
(W)
10^2
10
1
10^{-1}
10^{-2}
10^{-1}
1
10
10^2
10^3
10^4
I_Z (mA)
10^5
BZY88-C10
C11
C12
C13
C15
C16
C18
C20
C22
C24
C27
C30

VOLTAGE REGULATOR DIODES

Diffused silicon diodes in a DO-5 envelope for use in power stabilisation and transient suppression circuits.

The series consists of 22 normal polarity types (stud cathode) and 22 reverse polarity types (stud anode) with nominal zener voltages ranging from 10 to 75 V with a tolerance of ±5%.

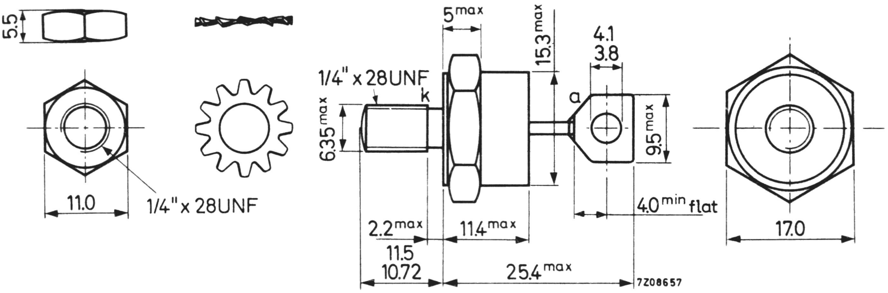
QUICK REFERENCE DATA

Zener voltage range		nom.	10 to 75	V
Zener voltage tolerance			±5	%
Repetitive peak zener current	I_{ZRM}	max.	100	A
Total power dissipation up to T_{mb} = 65 °C	P_{tot}	max.	75	W
Non repetitive peak reverse power T_{mb} = 65 °C; t = 100 μs	P_{ZSM}	max.	4.4	kW
Junction temperature	T_j	max.	175	°C
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.47	°C/W

MECHANICAL DATA

Dimensions in mm

DO-5


5.5
11.0
1/4" x 28UNF
5max
15.3max
1/4" x 28UNF
k
6.35max
4.1
3.8
a
9.5max
4.0min flat
2.2max
11.4max
11.5
10.72
25.4max
17.0
7Z08657

Polarity of connections: BZY91-C10 to C75 stud cathode
BZY91-C10R to C75R stud anode

Diameter of hole in heatsink: max. 6.5 mm
Accessories available: 56264A

Torque on nut: min. 17 cm kg
max. 35 cm kg

Net weight : 11 g
With accessories: 15 g

RATINGS (Limiting values) 1)

Currents

Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	10	A
Repetitive peak forward current	I_{FRM}	max.	30	A
Repetitive peak zener current	I_{ZRM}	max.	100	A

Power dissipation

Total power dissipation up to $T_{mb} = 65\ ^{o}C$	P_{tot}	max.	75	W
Non repetitive peak reverse power at $T_{mb} = 65\ ^{o}C$; $\delta = 0$				
$t = 100\ \mu s$	P_{ZSM}	max.	4.4	kW
$t = 1$ ms	P_{ZSM}	max.	1.48	kW
$t = 10$ ms	P_{ZSM}	max.	500	W
$t = 100$ ms	P_{ZSM}	max.	170	W

Temperatures

Storage temperature	T_{stg}		-55 to +175	^{o}C
Junction temperature	T_{j}	max.	175	^{o}C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.47	$^{o}C/W$
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.2	$^{o}C/W$

---

1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

CHARACTERISTICS at T_{mb} = 25 °C

Forward voltage at I_F = 10 A	V_F	< 1.5	V
Reverse current at $V_R = \frac{2}{3} \cdot V_{Znom}$	I_R	< 1	mA

BZY91-...	Zener voltage V_Z at I_Z = 2 A [1]			Differential resistance r_Z at I_Z = 2 A
	min.	nom.	max.	max.
C10(R)	9.4	10	10.6 V	0.4 Ω
C11(R)	10.4	11	11.6 V	0.4 Ω
C12(R)	11.4	12	12.6 V	0.5 Ω
C13(R)	12.4	13	14.1 V	0.5 Ω
C15(R)	13.9	15	15.6 V	0.6 Ω
C16(R)	15.4	16	17.1 V	0.6 Ω
C18(R)	16.9	18	19.1 V	0.7 Ω
	at I_Z = 1 A [1]			at I_Z = 1 A
	min.	nom.	max.	max.
C20(R)	18.9	20	21.2 V	0.8 Ω
C22(R)	20.8	22	23.3 V	0.8 Ω
C24(R)	22.7	24	25.9 V	0.9 Ω
C27(R)	25.1	27	28.9 V	1.0 Ω
C30(R)	28	30	32 V	1.1 Ω
C33(R)	31	33	35 V	1.2 Ω
C36(R)	34	36	38 V	1.3 Ω
	at I_Z = 0.5 A [1]			at I_Z = 0.5 A
	min.	nom.	max.	max.
C39(R)	37	39	41 V	1.4 Ω
C43(R)	40	43	45 V	1.5 Ω
C47(R)	44	47	50 V	1.7 Ω
C51(R)	48	51	54 V	1.8 Ω
C56(R)	53	56	60 V	2.0 Ω
C62(R)	58	62	66 V	2.2 Ω
C68(R)	64	68	72 V	2.4 Ω
C75(R)	71	75	79 V	2.6 Ω

---

[1]) The zener voltage is measured by a pulse method with $t_p \leqq 100\ \mu s$, duty cycle $\delta \leqq 0.001$ and $T_j \approx 25\ ^oC$

OPERATING NOTES

1. Dissipation and heatsink considerations

a. Steady-state conditions

The maximum allowable steady-state dissipation P_s is given by the relationship

$$P_{s\ max.} = \frac{T_{j\ max.} - T_{amb}}{R_{th\ j\text{-}a}}$$

where $T_{j\ max.}$ is the maximum permissible operating junction temperature,

T_{amb} is the ambient temperature,

$R_{th\ j\text{-}a}$ is the total thermal resistance from junction to ambient
$R_{th\ j\text{-}a} = R_{th\ j\text{-}mb} + R_{th\ mb\text{-}h} + R_{th\ h\text{-}a}$,

$R_{th\ mb\text{-}h}$ is the thermal resistance from mounting base to heatsink, that is 0.2 °C/W,

$R_{th\ h\text{-}a}$ is the thermal resistance of the heatsink

b. Pulse conditions (see fig. next page)

The maximum allowable additional pulse power $P_{m\ max.}$ is given by the formula

$$P_{m\ max.} = \frac{(T_{j\ max.} - T_{amb}) - (P_s \cdot R_{th\ j\text{-}a})}{R_{th\ t} + \delta \cdot R_{th\ mb\ a}}$$

where P_s is the steady-state dissipation, excluding that in the pulses,

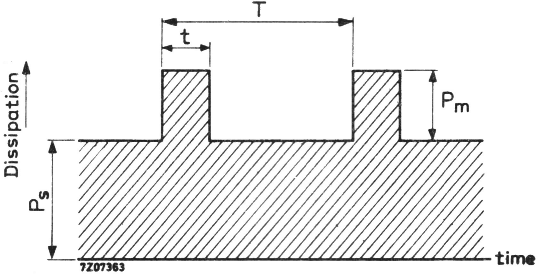
$R_{th\ t}$ is the effective transient thermal resistance of the device from junction to mounting base. It is a function of the pulse duration t and duty cycle δ (see page 8),

δ is the duty cycle and is equal to the pulse duration t divided by the period duration T,

$R_{th\ mb\text{-}a}$ is the total thermal resistance from mounting base to ambient. $R_{th\ mb\text{-}a} = R_{th\ mb\text{-}h} + R_{th\ h\text{-}a}$.

The steady-state power P_s when biased in the zener direction at a given zener current can be found from page 9, upper figure. With the additional pulsed power dissipation P_m calculated from the above expression, the total repetitive peak zener power dissipation $P_{ZRM} = P_s + P_m$. From page 9, upper figure the corresponding maximum repetitive peak zener current at P_{ZRM} can now be read. This repetitive peak zener current is subject to the absolute maximum rating. For pulse durations longer than the temperature stabilisation time of the diode t_{stab}, the maximum allowable repetitive peak dissipation P_{ZRM} is equal to the maximum steady-state power $P_{s\ max.}$ The temperature stabilisation time for the BZY91series is 2 s (see page 8).

OPERATING NOTES (continued)



2. Care must be taken to ensure that the connecting lug is not bent or twisted.

Example

The following example illustrates how to calculate the maximum permissible repetitive peak zener current of a BZY91-C56 zener diode mounted on a heatsink with $R_{th\ h\text{-}a} = 2\ ^\circ C/W$ at a maximum ambient temperature of 50 °C. The steady-state zener current is 0.5 A, the duty cycle $\delta = 0.1$ and the pulse duration $t = 1$ ms.

The steady-state dissipation P_S at a zener current of 0.5 A (from page 9, upper figure) = 28 W.
The thermal resistance from junction to ambient $R_{th\ j\text{-}a} = R_{th\ j\text{-}mb} + R_{th\ mb\text{-}h} + R_{th\ h\text{-}a} = 1.47 + 0.2 + 2 = 3.67\ ^\circ C/W$.
The transient thermal resistance $R_{th\ t}$ with a duty cycle $\delta = 0.1$ and a pulse duration $t = 1$ ms (from page 8, lower figure)

$$R_{th\ t} = 0.23\ ^\circ C/W$$

The maximum additional pulse power dissipation

$$P_{m\ max.} = \frac{(T_{j\ max} - T_{amb}) - P_s \cdot R_{th\ j\text{-}a}}{R_{th\ t} + \delta \cdot R_{th\ mb\text{-}a}}$$

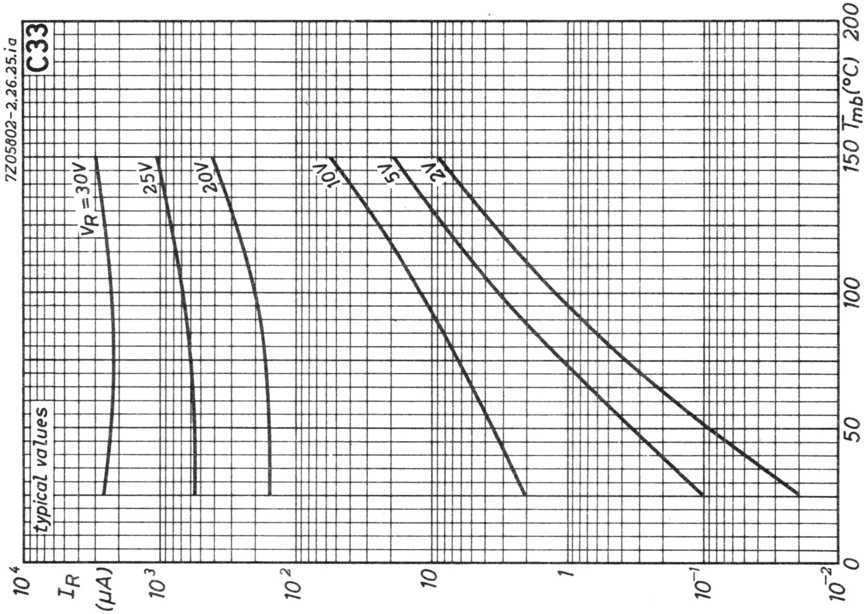
If $P_S = 28$ W, $R_{th\ t} = 0.23\ ^\circ C/W$,

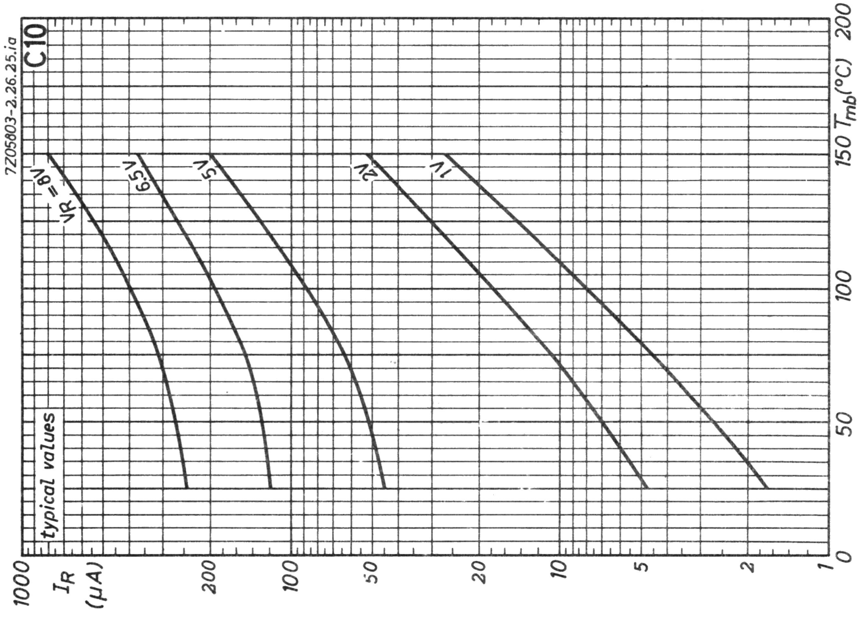
then $$P_{m\ max} = \frac{(175 - 50) - (28 \times 3.67)}{0.23 + 0.1 \times 2.2} = 49\ W$$

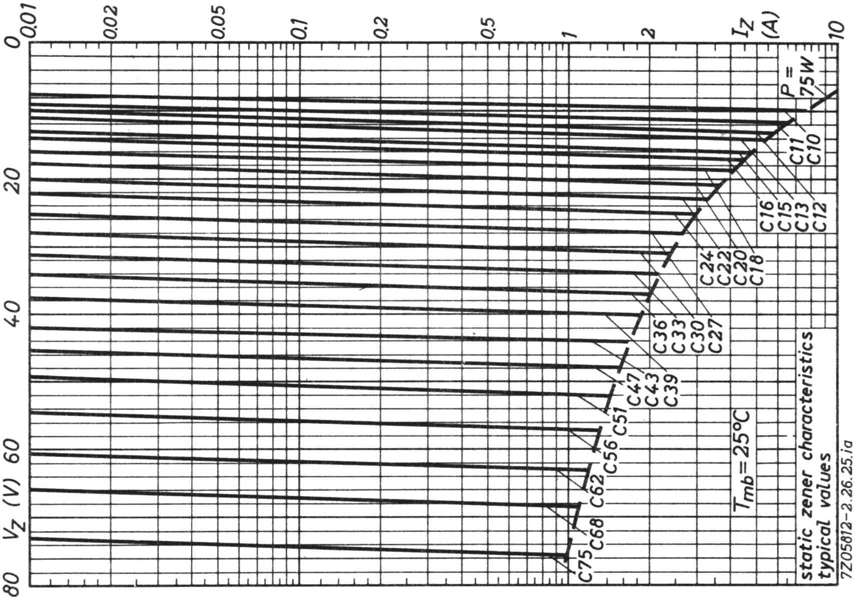
therefore, the total repetitive peak power dissipation,

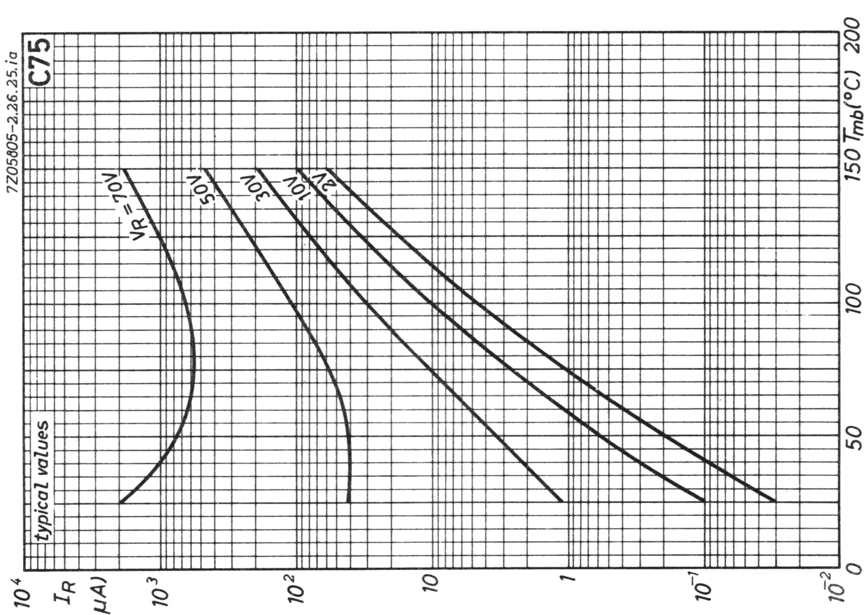
$$P_{ZRM} = (28\ W + 49\ W) = 77\ W$$

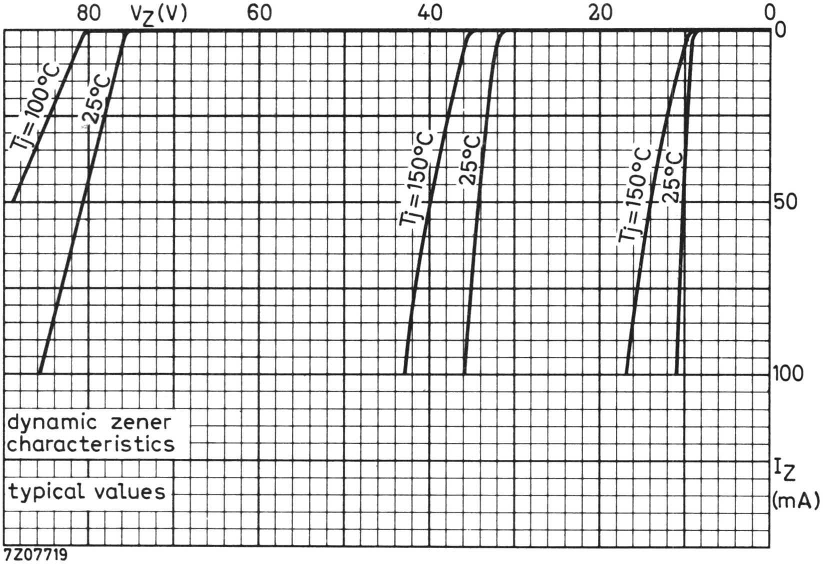
From page 9, upper figure, the corresponding repetitive peak zener current is 1.3 A. This is within the rating of the BZY91-C56 and is therefore permissible.

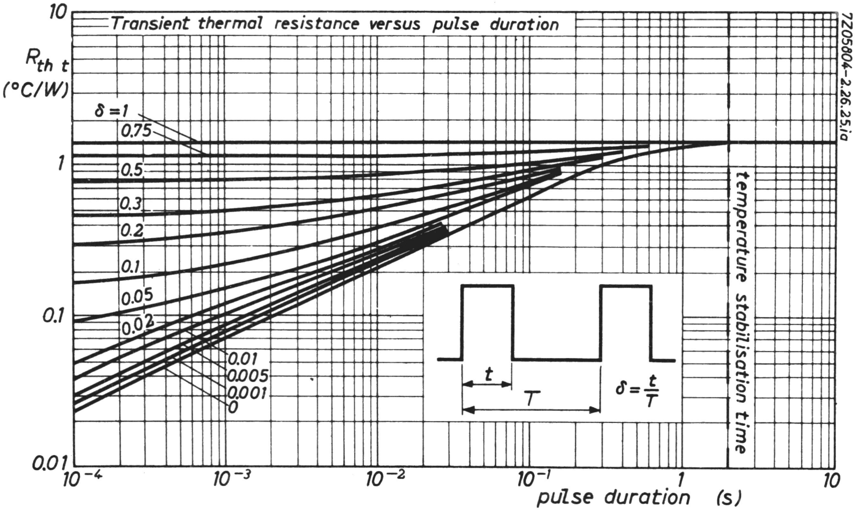

7Z05802-2.26.25.ia
C33
typical values
$V_R = 30V$
25V
20V
10V
5V
2V
I_R (μA)
10^4
10^3
10^2
10
1
10^{-1}
10^{-2}
0
50
100
150
200
T_{mb} (°C)

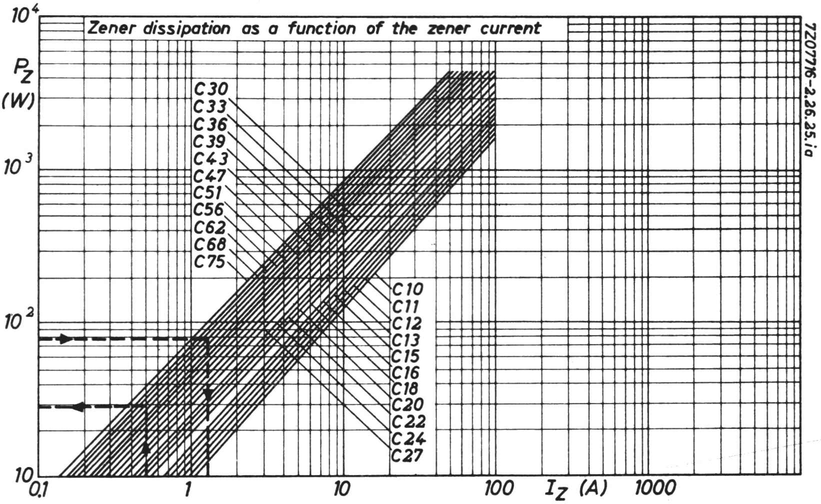

7Z05803-2.26.25.ia
C10
typical values
$V_R = 8V$
6.5V
5V
2V
1V
I_R (μA)
1000
200
100
50
20
10
5
2
1
0
50
100
150
200
T_{mb} (°C)

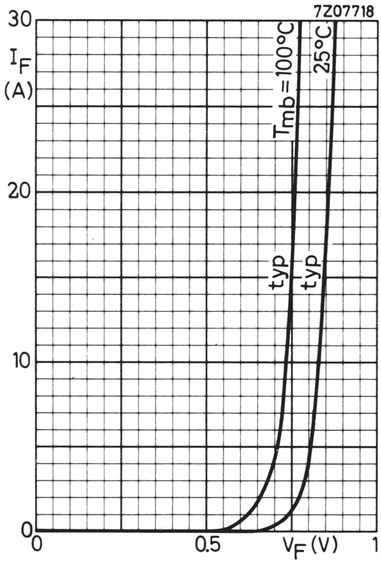

0
20
40
60
80
V_Z (V)
0.01
0.02
0.05
0.1
0.2
0.5
1
2
I_Z (A)
10
P = 75W
C10
C11
C12
C13
C15
C16
C18
C20
C22
C24
C27
C30
C33
C36
C39
C43
C47
C51
C56
C62
C68
C75
T_mb = 25°C
static zener characteristics
typical values
7Z05812-2.26.25.ia

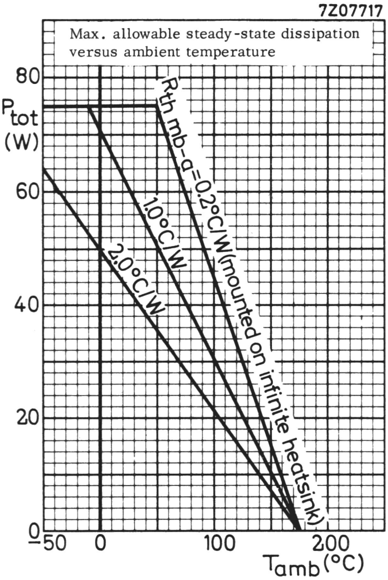

C75
7Z05805-2.26.25.ia
typical values
V_R = 70V
50V
30V
10V
2V
10^4
I_R (μA)
10^3
10^2
10
1
10^-1
10^-2
0
50
100
150 T_mb (°C)
200

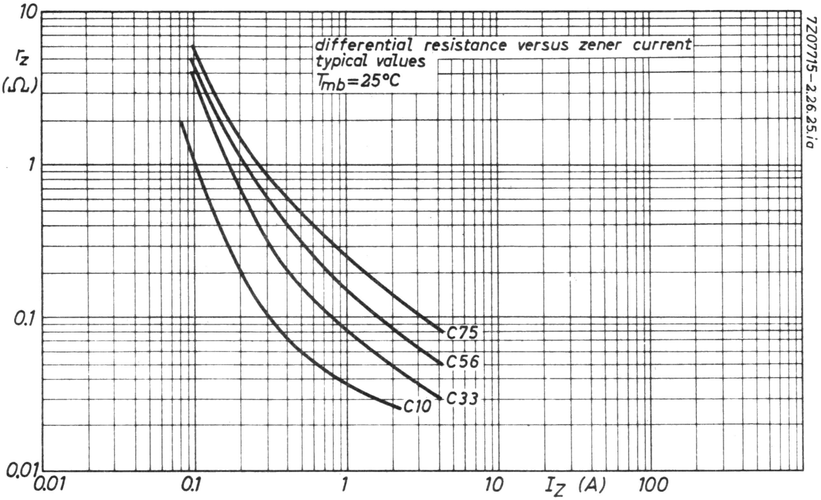

80
V_Z(V)
60
40
20
0
0
50
100
I_Z
(mA)
T_j=100°C
25°C
T_j=150°C
25°C
T_j=150°C
25°C
dynamic zener characteristics
typical values
7Z07719

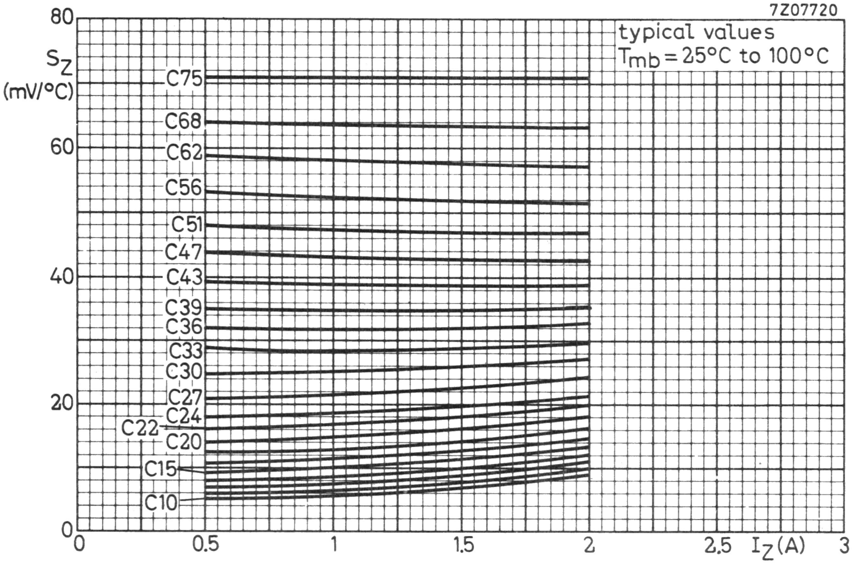

Transient thermal resistance versus pulse duration
$R_{th\ t}$
(°C/W)
10
1
0.1
0.01
δ = 1
0.75
0.5
0.3
0.2
0.1
0.05
0.02
0.01
0.005
0.001
0
t
T
$\delta = \frac{t}{T}$
temperature stabilisation time
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
pulse duration (s)
7Z05804-2.26.25.ia


Zener dissipation as a function of the zener current
7Z07716-2.26.25.ia
P_Z
(W)
10^4
10^3
10^2
10
C30
C33
C36
C39
C43
C47
C51
C56
C62
C68
C75
C10
C11
C12
C13
C15
C16
C18
C20
C22
C24
C27
0.1
1
10
100
I_Z (A)
1000


7Z07718
30
I_F
(A)
20
10
0
T_{mb} = 100°C
25°C
typ
typ
0
0.5
V_F (V)
1


7Z07717
Max. allowable steady-state dissipation versus ambient temperature
80
P_{tot}
(W)
60
40
20
0
$R_{th\ mb-a}$ = 0.2°C/W (mounted on infinite heatsink)
1.0°C/W
2.0°C/W
−50
0
100
200
T_{amb} (°C)


differential resistance versus zener current
typical values
T_{mb}=25°C
r_z
(Ω)
10
1
0.1
0.01
0.01
0.1
1
10
100
I_Z (A)
C75
C56
C33
C10
7Z07715-2.26.25.ia


7Z07720
typical values
T_{mb} = 25°C to 100°C
S_Z
(mV/°C)
80
60
40
20
0
0
0.5
1
1.5
2
2.5
3
I_Z(A)
C75
C68
C62
C56
C51
C47
C43
C39
C36
C33
C30
C27
C24
C22
C20
C15
C10

SILICON POWER VOLTAGE REGULATORS

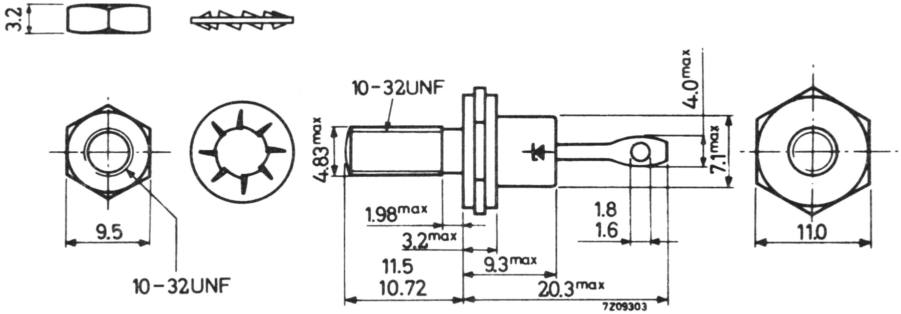
Diffused silicon diodes in a DO-4 metal envelope intended for general purpose applications.
The series consists of 25 normal polarity types (stud cathode) and 25 reverse polarity types (stud anode) with nominal zener voltages ranging from 7.5 V to 75 V with a tolerance of ±5%.

QUICK REFERENCE DATA

Zener voltage range		nom.	7.5 to 75	V
Zener voltage tolerance			±5	%
Repetitive peak zener current	I_{ZRM}	max.	20	A
Total power dissipation up to T_{mb} = 75 °C	P_{tot}	max.	20	W
Non repetitive peak reverse power dissipation T_j = 175 °C; t = 100 μs	P_{ZSM}	max.	500	W
Junction temperature	T_j	max.	175	°C
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=	5.0	°C/W

MECHANICAL DATA Dimensions in mm

DO-4



Net weight : 4.3 g
With accessories: 6.5 g
Diameter of hole in heatsink: max. 5.2 mm
Accessories available: 56295 (56262A)

Torque on nut: min. 8 cm kg
max. 17 cm kg
The mark shown applies to normal polarity types

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Currents

Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	5	A
Repetitive peak forward current	I_{FRM}	max.	15	A
Repetitive peak zener current	I_{ZRM}	max.	20	A

Power dissipation

Total power dissipation up to T_{mb} = 75 °C	P_{tot}	max.	20	W
Non repetitive peak reverse power dissipation, T_j = 175 °C; t = 100 μs	P_{ZSM}	max.	500	W

Temperatures

Storage temperature	T_{stg}		−65 to +175	°C
Junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	5.0	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.6	°C/W

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Forward voltage at I_F = 5 A	V_F	<	1.5	V

Reverse current at			BZY93- C7V5(R)	C8V2(R)	C9V1(R) to C75(R)	
V_R = 2 V	I_R	<	100			μA
V_R = 5.6 V	I_R	<		100		μA
$V_R = \frac{2}{3} \cdot V_{Znom}$	I_R	<			50	μA

CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

BZY93-...	Zener voltage V_Z			Temperature coefficient	Differential resistance	
	at I_Z = 2 A			at I_Z = 2 A	at I_Z = 2 A	
	min.	nom.	max.	typ.	typ.	max.
C7V5(R)	7.1	7.5	7.9 V	3.0 mV/°C	0.04	0.3 Ω
C8V2(R)	7.7	8.2	8.7 V	4.0 mV/°C	0.05	0.3 Ω
	at I_Z = 1 A			at I_Z = 1 A	at I_Z = 1 A	
	min.	nom.	max.	typ.	typ.	max.
C9V1(R)	8.6	9.1	9.6 V	5.0 mV/°C	0.07	0.5 Ω
C10(R)	9.4	10	10.6 V	7.0 mV/°C	0.07	0.5 Ω
C11(R)	10.4	11	11.6 V	7.5 mV/°C	0.08	1.0 Ω
C12(R)	11.4	12	12.6 V	8.0 mV/°C	0.08	1.0 Ω
C13(R)	12.4	13	14.1 V	8.5 mV/°C	0.08	1.0 Ω
C15(R)	13.9	15	15.6 V	10.0 mV/°C	0.10	1.2 Ω
	at I_Z = 0.5 A			at I_Z = 0.5 A	at I_Z = 0.5 A	
	min.	nom.	max.	typ.	typ.	max.
C16(R)	15.4	16	17.1 V	11 mV/°C	0.18	1.2 Ω
C18(R)	16.9	18	19.1 V	12 mV/°C	0.20	1.5 Ω
C20(R)	18.9	20	21.2 V	14 mV/°C	0.20	1.5 Ω
C22(R)	20.8	22	23.3 V	16 mV/°C	0.21	1.8 Ω
C24(R)	22.7	24	25.9 V	18 mV/°C	0.22	2.0 Ω
C27(R)	25.1	27	28.9 V	21 mV/°C	0.25	2.0 Ω
C30(R)	28	30	32 V	25 mV/°C	0.30	2.5 Ω
C33(R)	31	33	35 V	30 mV/°C	0.32	3.0 Ω
	at I_Z = 0.2 A			at I_Z = 0.2 A	at I_Z = 0.2 A	
	min.	nom.	max.	typ.	typ.	max.
C36(R)	34	36	38 V	32 mV/°C	0.75	4.0 Ω
C39(R)	37	39	41 V	35 mV/°C	0.85	5.0 Ω
C43(R)	40	43	45 V	40 mV/°C	0.90	6.5 Ω
C47(R)	44	47	50 V	45 mV/°C	1.0	7.0 Ω
C51(R)	48	51	54 V	50 mV/°C	1.2	7.5 Ω
C56(R)	53	56	60 V	55 mV/°C	1.3	8.0 Ω
C62(R)	58	62	66 V	60 mV/°C	1.5	9.0 Ω
C68(R)	64	68	72 V	65 mV/°C	1.8	10.0 Ω
C75(R)	71	75	79 V	70 mV/°C	2.0	10.5 Ω

OPERATING NOTES

1. Dissipation and heatsink considerations

a. Steady-state conditions

The maximum allowable steady-state dissipation $P_{s\,max}$ is given by the relationship

$$P_{s\,max} = \frac{T_{j\,max} - T_{amb}}{R_{th\,j-a}}$$

where $T_{j\,max}$ is the maximum permissible operating junction temperature.

T_{amb} is the ambient temperature,

$R_{th\,j-a}$ is the total thermal resistance from junction to ambient
$R_{th\,j-a} = R_{th\,j-mb} + R_{th\,mb-h} + R_{th\,h-a}$,

$R_{th\,mb-h}$ is the thermal resistance from mounting base to heatsink, that is 0.6 °C/W,

$R_{th\,h-a}$ is the thermal resistance of the heatsink

b. Pulse conditions (see fig. next page)

The maximum allowable additional pulse power $P_{m\,max}$ is given by the formula

$$P_{m\,max} = \frac{(T_{j\,max} - T_{amb}) - (P_s \cdot R_{th\,j-a})}{R_{th\,t} + \delta \cdot R_{th\,mb-a}}$$

where P_s is the steady-state dissipation, excluding that in the pulses,

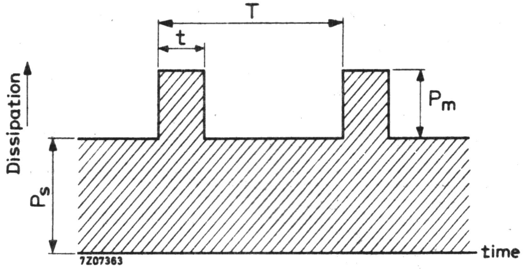
$R_{th\,t}$ is the effective transient thermal resistance of the device from junction to mounting base. It is a function of the pulse duration t and duty cycle δ (see page 6, upper figure).

δ is the duty cycle and is equal to the pulse duration t divided by the period duration T,

$R_{th\,mb-a}$ is the total thermal resistance from mounting base to ambient. $R_{th\,mb-a} = R_{th\,mb-h} + R_{th\,h-a}$.

The steady-state power P_s when biased in the zener direction at a given zener current can be found from page 8, upper figure. With the additional pulsed power dissipation $P_{m\,max}$ calculated from the above expression, the total repetitive peak zener power dissipation $P_{ZRM} = P_s + P_{m\,max}$. From page 8, upper figure the corresponding maximum repetitive peak zener current at P_{ZRM} can now be read. This repetitive peak zener current is subject to the absolute maximum rating. For pulse durations longer than the temperature stabilisation time of the diode t_{stab}, the maximum allowable repetitive peak dissipation P_{ZRM} is equal to the maximum steady-state power $P_{s\,max}$. The temperature stabilisation time for the BZY93series is 5 s (see page 6, upper figure).

OPERATING NOTES (continued)



2. Care must be taken to ensure that the connecting lug is not bent or twisted.

Example

The following example illustrates how to calculate the maximum permissible repetitive peak zener current of a BZY93-C12 zener diode mounted on a heatsink with $R_{th\ h\text{-}a} = 2\ ^oC/W$ at a maximum ambient temperature of 50 °C. The steady-state zener current is 0.5 A, the duty cycle $\delta = 0.1$ and the pulse duration $t = 1$ ms.

The steady-state dissipation P_s at a zener current of 0.5 A (from page 8, upper figure) = 7 W.
The thermal resistance from junction to ambient $R_{th\ j\text{-}a} = R_{th\ j\text{-}mb} + R_{th\ mb\text{-}h} + R_{th\ h\text{-}a} = 5 + 0.6 + 2 = 7.6\ ^oC/W$.
The transient thermal resistance $R_{th\ t}$ with a duty cycle $\delta = 0.1$ and a pulse duration $t = 1$ ms (from page 6, upper figure)

$$R_{th\ t} = 0.92\ ^oC/W$$

The maximum additional pulse power dissipation

$$P_{m\ max} = \frac{(T_{j\ max} - T_{amb}) - P_s \cdot R_{th\ j\text{-}a}}{R_{th\ t} + \delta \cdot R_{th\ mb\text{-}a}}$$

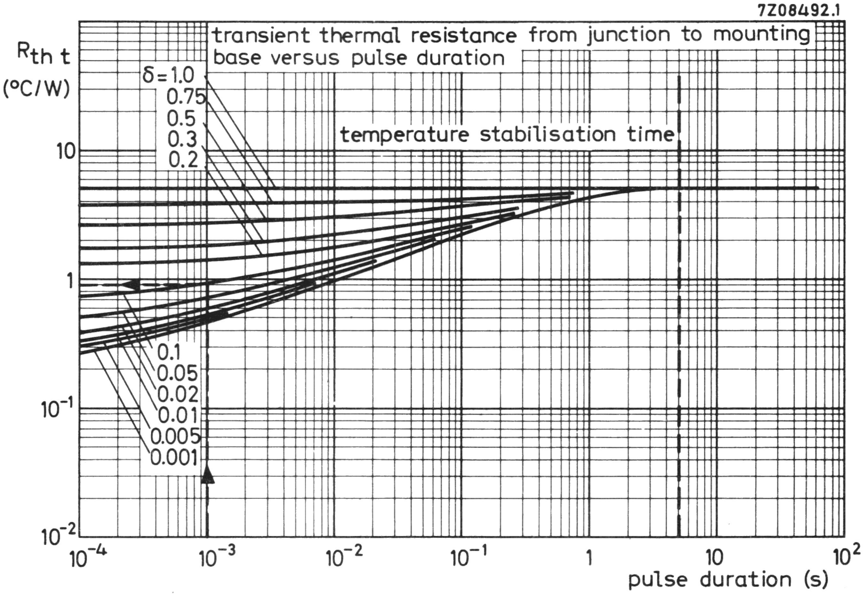
If $P_s = 7$ W, $R_{th\ t} = 0.92\ ^oC/W$,

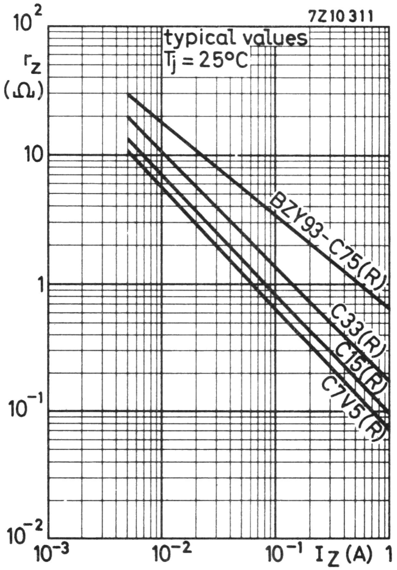
$$P_{m\ max} = \frac{(175 - 50) - (7 \times 7.6)}{0.92 + 0.1 \times 2.6} = 61\ W$$

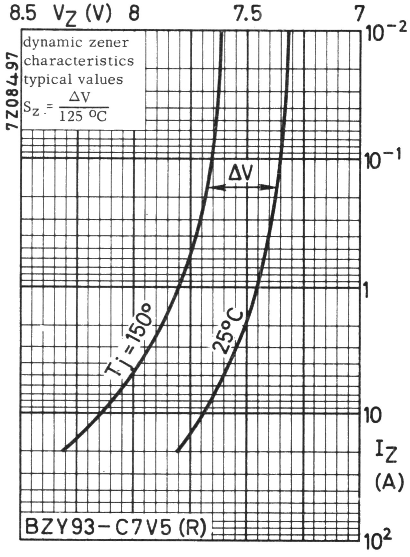
therefore, the total repetitive peak power dissipation,

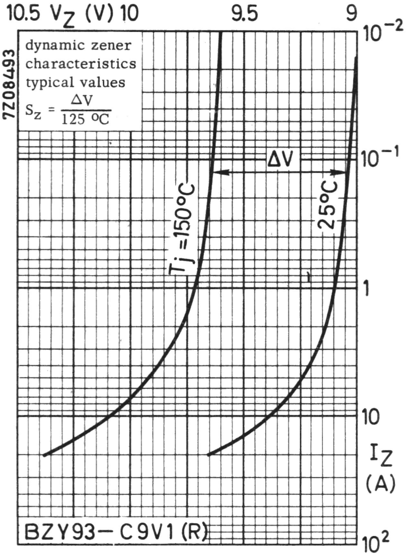
$$P_{ZRM} = (7 + 61) = 68\ W$$

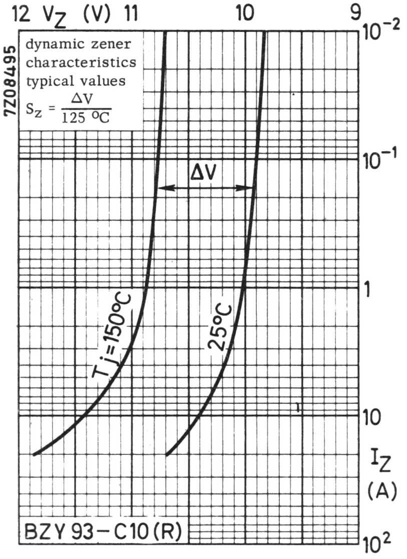
From page 8, upper figure, the corresponding repetitive peak zener current is 5 A. This is within the rating of the BZY93-C12 and is therefore permissible.

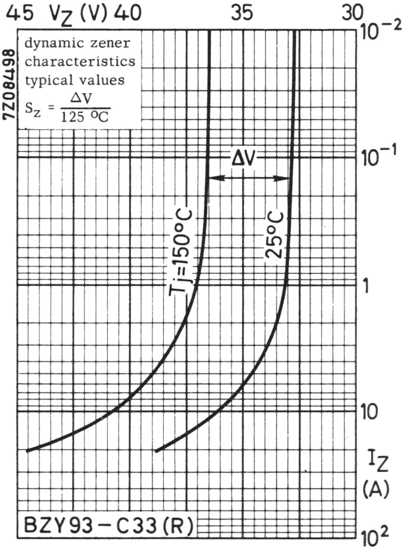

7Z08492.1
transient thermal resistance from junction to mounting base versus pulse duration
$R_{th\ t}$
(°C/W)
δ=1.0
0.75
0.5
0.3
0.2
temperature stabilisation time
10
1
10^{-1}
10^{-2}
0.1
0.05
0.02
0.01
0.005
0.001
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
10^{2}
pulse duration (s)

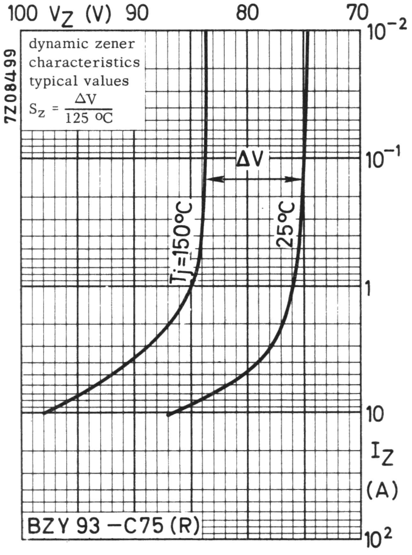

7Z10311
typical values
$T_j = 25°C$
r_z
(Ω)
10^{2}
10
1
10^{-1}
10^{-2}
BZY93-C75(R)
C33(R)
C15(R)
C7V5(R)
10^{-3}
10^{-2}
10^{-1}
I_Z (A)
1

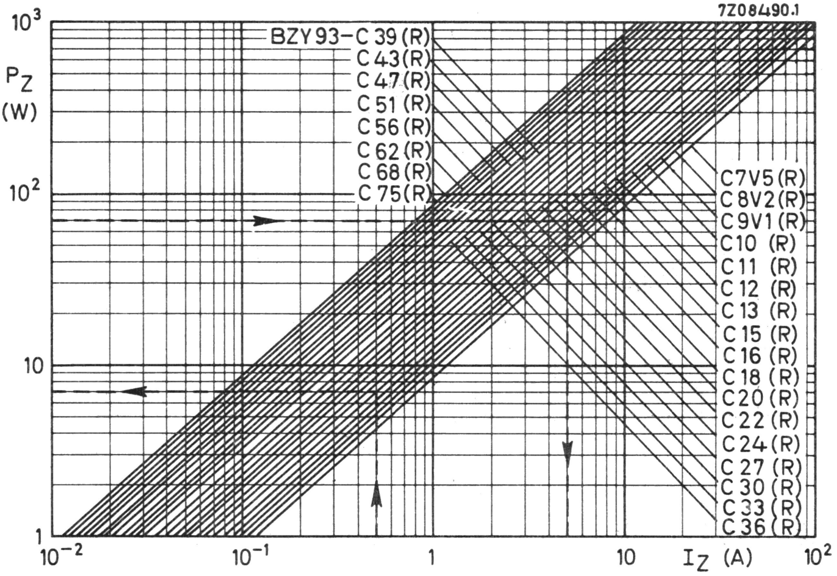

8.5
V_Z (V)
8
7.5
7
7Z08497
dynamic zener characteristics typical values
$S_Z = \frac{\Delta V}{125\ °C}$
ΔV
$T_j = 150°$
25°C
BZY93-C7V5 (R)
10^{-2}
10^{-1}
1
10
I_Z
(A)
10^{2}

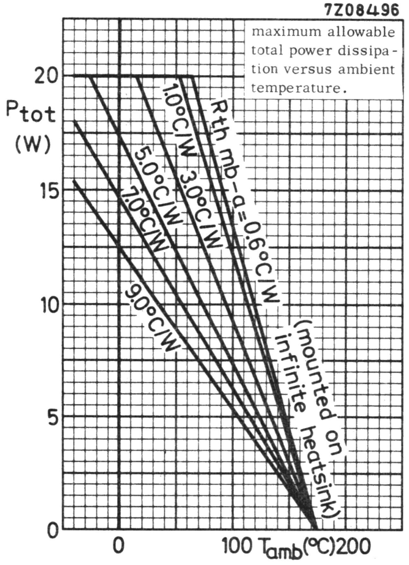

10.5 V_Z (V) 10 9.5 9
7Z08493
dynamic zener characteristics typical values
$S_Z = \frac{\Delta V}{125\ ^{o}C}$
ΔV
T_j =150°C
25°C
10^{-2}
10^{-1}
1
10
10^2
I_Z (A)
BZY93– C9V1 (R)

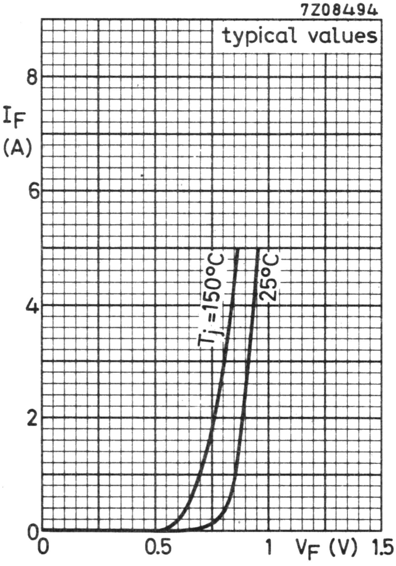

12 V_Z (V) 11 10 9
7Z08495
dynamic zener characteristics typical values
$S_Z = \frac{\Delta V}{125\ ^{o}C}$
ΔV
T_j=150°C
25°C
10^{-2}
10^{-1}
1
10
10^2
I_Z (A)
BZY 93– C10 (R)


45 V_Z (V) 40 35 30
7Z08498
dynamic zener characteristics typical values
$S_Z = \frac{\Delta V}{125\ ^{o}C}$
ΔV
T_j=150°C
25°C
10^{-2}
10^{-1}
1
10
10^2
I_Z (A)
BZY93 – C33 (R)


100 V_Z (V) 90 80 70
7Z08499
dynamic zener characteristics typical values
$S_Z = \frac{\Delta V}{125\ ^{o}C}$
ΔV
T_j=150°C
25°C
10^{-2}
10^{-1}
1
10
10^2
I_Z (A)
BZY 93 –C75 (R)


7Z08490.1
10^3
P_Z
(W)
10^2
10
1
10^{-2}
10^{-1}
1
10
I_Z (A)
10^2
BZY93-C 39(R)
C 43(R)
C 47(R)
C 51(R)
C 56(R)
C 62(R)
C 68(R)
C 75(R)
C7V5(R)
C 8V2(R)
C 9V1(R)
C10 (R)
C11 (R)
C 12 (R)
C 13 (R)
C 15 (R)
C 16 (R)
C 18 (R)
C 20 (R)
C 22 (R)
C 24 (R)
C 27 (R)
C 30 (R)
C 33 (R)
C 36 (R)


7Z08496
maximum allowable total power dissipation versus ambient temperature.
P_{tot}
(W)
20
15
10
5
0
0
100
T_{amb} (°C)
200
$R_{th\ mb-a}$ = 0.6°C/W
(mounted on infinite heatsink)
1.0°C/W
3.0°C/W
5.0°C/W
7.0°C/W
9.0°C/W


7Z08494
typical values
I_F
(A)
8
6
4
2
0
0
0.5
1
V_F (V)
1.5
T_j = 150°C
25°C

MEDIUM POWER VOLTAGE REGULATORS

Diffused silicon diodes in a DO-1 metal case for use as medium power voltage stabilisers or voltage references.
The series consist of 22 normal polarity types (stud-cathode) with nominal zener voltages ranging from 10 V to 75 V with a tolerance of ± 5%.

RATINGS (Limiting values according to the Absolute Maximum System as defined in IEC publication 134).

Currents

Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	1	A
Repetitive peak forward current	I_{FRM}	max.	3	A
Repetitive peak zener current	I_{ZRM}	max.	5	A

Power dissipation

Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1.5	W
Non repetitive peak reverse power	P_{ZSM}	max.	100	W

Temperatures

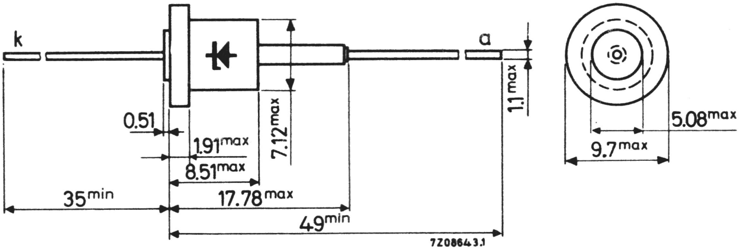
Storage temperature	T_{stg}		-65 to +175	°C
Junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	100	°C/W

MECHANICAL DATA Dimensions in mm

DO-1



CHARACTERISTICS T_j = 25 °C unless otherwise specified

Forward voltage at I_F = 1.0 A V_F < 1.5 V

Reverse current at $V_R = \frac{2}{3} \cdot V_{Z\,nom}$ I_R < 10 μA

BZY95-...	Zener voltage at I_Z = 50 mA			Temperature coefficient at I_Z = 50 mA	Differential resistance at I_Z = 50 mA	
	min.	nom.	max.	typ.	typ.	max.
C10	9.4	10	10.6 V	7.0 mV/°C	0.75	4.0 Ω
C11	10.4	11	11.6 V	7.5 mV/°C	0.80	4.5 Ω
C12	11.4	12	12.6 V	8.0 mV/°C	0.85	5.0 Ω
C13	12.4	13	14.1 V	8.5 mV/°C	0.90	6.0 Ω
C15	13.9	15	15.6 V	10.0 mV/°C	1.0	8.0 Ω
	at I_Z = 20 mA			at I_Z = 20 mA	at I_Z = 20 mA	
	min.	nom.	max.	typ.	typ.	max.
C16	15.4	16	17.1 V	11 mV/°C	2.4	9 Ω
C18	16.9	18	19.1 V	12 mV/°C	2.5	11 Ω
C20	18.9	20	21.2 V	14 mV/°C	2.8	12 Ω
C22	20.8	22	23.3 V	16 mV/°C	3.0	13 Ω
C24	22.7	24	25.9 V	18 mV/°C	3.4	14 Ω
C27	25.1	27	28.9 V	20 mV/°C	3.8	18 Ω
C30	28	30	32 V	25 mV/°C	4.5	22 Ω
C33	31	33	35 V	30 mV/°C	5.0	25 Ω
C36	34	36	38 V	32 mV/°C	5.5	30 Ω
	at I_Z = 10 mA			at I_Z = 10 mA	at I_Z = 10 mA	
	min.	nom.	max.	typ.	typ.	max.
C39	37	39	41 V	35 mV/°C	12	35 Ω
C43	40	43	45 V	40 mV/°C	13	40 Ω
C47	44	47	50 V	45 mV/°C	14	50 Ω
C51	48	51	54 V	50 mV/°C	15	55 Ω
C56	53	56	60 V	55 mV/°C	17	63 Ω
C62	58	62	66 V	60 mV/°C	18	75 Ω
C68	64	68	72 V	65 mV/°C	18	90 Ω
C75	71	75	79 V	70 mV/°C	20	100 Ω

MEDIUM POWER VOLTAGE REGULATORS

Alloyed silicon diodes in a DO-1 metal case for use as medium power voltage stabilisers or voltage references.
The series consists of 8 normal polarity types (stud-cathode) with nominal zener voltages ranging from 4.7 V to 9.1 V with a tolerance of ±5%.

RATINGS (Limiting values according to the Absolute Maximum System as defined in IEC publication 134).

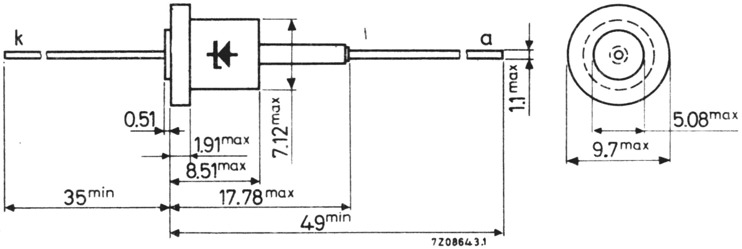
Currents				
Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	1	A
Repetitive peak forward current	I_{FRM}	max.	3	A
Repetitive peak zener current	I_{ZRM}	max.	3.5	A
Power dissipation				
Total power dissipation up to $T_{amb} = 25\ ^{o}C$	P_{tot}	max.	1.5	W
Non repetitive peak reverse power	P_{ZSM}	max.	20	W
Temperatures				
Storage temperature	T_{stg}		−65 to +175	°C
Junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	100	°C/W

MECHANICAL DATA Dimensions in mm

DO-1



CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Forward voltage at I_F = 1.0 A — V_F < 1.5 V

Reverse current

BZY96-C4V7	V_R = 1.0 V	I_R	< 20 μA
C5V1	V_R = 1.0 V	I_R	< 20 μA
C5V6	V_R = 1.0 V	I_R	< 20 μA
C6V2	V_R = 2.0 V	I_R	< 20 μA
C6V8	V_R = 2.0 V	I_R	< 20 μA
C7V5	V_R = 3.0 V	I_R	< 20 μA
C8V2	V_R = 5.6 V	I_R	< 20 μA
C9V1	V_R = 6.2 V	I_R	< 20 μA

BZY96-...	Zener voltage at I_Z = 100 mA			Temperature coefficient at I_Z = 100 mA	Differential resistance at I_Z = 100 mA	
	min.	nom.	max.	typ.	typ.	max.
C4V7	4.4	4.7	5.0 V	−0.6 mV/°C	2.5	10 Ω
C5V1	4.8	5.1	5.4 V	+0.1 mV/°C	1.0	5.0 Ω
C5V6	5.3	5.6	6.0 V	+1.0 mV/°C	0.7	4.0 Ω
C6V2	5.8	6.2	6.6 V	+2.0 mV/°C	0.6	3.0 Ω
C6V8	6.4	6.8	7.2 V	+3.0 mV/°C	0.6	3.0 Ω
	at I_Z = 50 mA			at I_Z = 50 mA	at I_Z = 50 mA	
	min.	nom.	max.	typ.	typ.	max.
C7V5	7.1	7.5	7.9 V	+4.0 mV/°C	1.0	3.5 Ω
C8V2	7.7	8.2	8.7 V	+5.0 mV/°C	1.2	3.5 Ω
C9V1	8.6	9.1	9.6 V	+6.4 mV/°C	1.8	4.5 Ω

MEDIUM POWER VOLTAGE REGULATORS

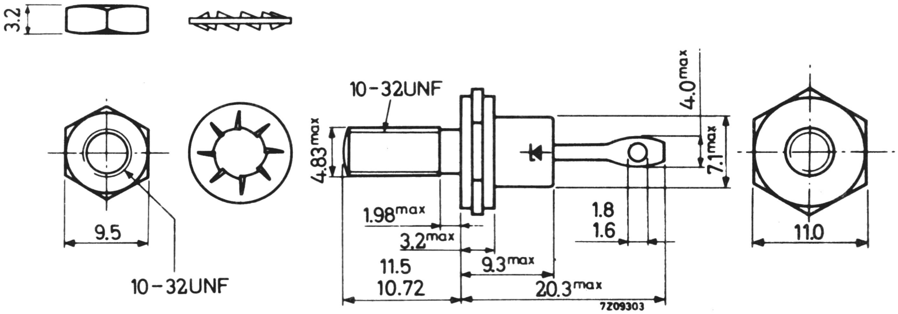
Alloyed silicon diodes in a DO-4 metal envelope for use as medium-current voltage stabilisers or voltage references.
Zener voltage range from 5.6 to 24 V with a tolerance of ±5%.

QUICK REFERENCE DATA				
Zener voltage range (tolerance ±5%)		nom.	5.6 to 24	V
Repetitive peak zener current	I_{ZRM}	max.	7	A
Total power dissipation up to T_{mb} = 50 °C	P_{tot}	max.	10	W
Non repetitive peak reverse power dissipation	P_{ZSM}	max.	45	W
Junction temperature	T_j	max.	150	°C
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=	10	°C/W

MECHANICAL DATA

Dimensions in mm

DO-4


3.2
10-32UNF
4.83max
4.0max
7.1max
9.5
10-32UNF
1.98max
3.2max
11.5
10.72
9.3max
20.3max
1.8
1.6
11.0
7Z09303

The mark shown applies to normal polarity types

Net weight 4.3 g
With accessories 6.5 g

Mounting torque: min. 8 cm kg
max. 17 cm kg

Diameter of hole in heatsink: max. 5.2 mm
Accessories available for insulated mounting: 56295 (56262A)

RATINGS (Limiting values) [1]

Currents

Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	0.5	A
Repetitive peak forward current	I_{FRM}	max.	7	A
Repetitive peak zener current	I_{ZRM}	max.	7	A

Power dissipation

Total power dissipation up to T_{mb} = 50 °C	P_{tot}	max.	10	W
Non repetitive peak reverse power ($t < 100\ \mu s$)	P_{ZSM}	max.	45	W

Temperatures

Storage temperature	T_{stg}		−55 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	70	°C/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	10	°C/W

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

Forward voltage

I_F = 200 mA	V_F	<	1.0	V

Reverse current

BZZ14	V_R = 2 V	I_R	<	500	nA
BZZ15	V_R = 2 V	I_R	<	500	nA
BZZ16	V_R = 3 V	I_R	<	500	nA
BZZ17	V_R = 3 V	I_R	<	500	nA
BZZ18	V_R = 3 V	I_R	<	400	nA
BZZ19	V_R = 5 V	I_R	<	400	nA
BZZ20	V_R = 5 V	I_R	<	400	nA
BZZ21 to 29	V_R = 5 V	I_R	<	50	nA

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[1] Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

CHARACTERISTICS (continued) T_{mb} = 25 °C unless otherwise specified

Diode capacitance

BZZ14	V_R = 3 V	C_d	typ.	575	pF
BZZ15	V_R = 3 V	C_d	typ.	475	pF
BZZ16	V_R = 3 V	C_d	typ.	375	pF
BZZ17	V_R = 2 V	C_d	typ.	350	pF
BZZ18	V_R = 2 V	C_d	typ.	300	pF
BZZ19	V_R = 2 V	C_d	typ.	250	pF
BZZ20	V_R = 2 V	C_d	typ.	250	pF
BZZ21	V_R = 3 V	C_d	typ.	340	pF
BZZ22	V_R = 3 V	C_d	typ.	280	pF
BZZ23	V_R = 3 V	C_d	typ.	260	pF
BZZ24	V_R = 3 V	C_d	typ.	240	pF
BZZ25	V_R = 3 V	C_d	typ.	210	pF
BZZ26	V_R = 3 V	C_d	typ.	200	pF
BZZ27	V_R = 3 V	C_d	typ.	155	pF
BZZ28	V_R = 3 V	C_d	typ.	135	pF
BZZ29	V_R = 3 V	C_d	typ.	130	pF

	Zener voltage V_Z (V) at I_Z = 20 mA			Temperature coefficient S_Z (mV/°C) at I_Z = 20 mA			Differential resistance r_Z (Ω) at I_Z = 20 mA	
	min.	nom.	max.	min.	typ.	max.	typ.	max.
BZZ14	5.3	5.6	6.0	−0.4	+0.7	+2.5	4.5	15
BZZ15	5.8	6.2	6.6	+1.0	+2.1	+3.5	2.2	6.0
BZZ16	6.4	6.8	7.2	+2.0	+2.9	+4.0	2.07	5.0
BZZ17	7.1	7.5	7.9	+3.0	+3.75	+4.5	2.3	7.5
BZZ18	7.7	8.2	8.7	+4.0	+4.7	+6.0	2.6	10
BZZ19	8.6	9.1	9.6	+3.5	+5.8	+6.5	3.18	10
BZZ20	9.4	10	10.6	+6.0	+7.0	+8.0	3.8	17
BZZ21	10.4	11	11.6		+7.5		4.4	25
BZZ22	11.4	12	12.6		+8.8		5.25	28
BZZ23	12.4	13	14.1		+10		6.3	33
BZZ24	13.9	15	15.6		+12.6		8.9	39
BZZ25	15.4	16	17.1		+13.8		10.5	48
BZZ26	16.9	18	19.1		+16.4		14.5	54
BZZ27	18.9	20	21.2		+19		19.5	58
BZZ28	20.8	22	23.3		+21.6		26	63
BZZ29	22.7	24	25.9		+24.2		33.5	70

CHARACTERISTICS (continued)

T_{mb} = 25 °C unless otherwise specified

	Zener voltage V_Z (V) at I_Z = 100 mA			Temperature coefficient S_Z (mV/°C) at I_Z = 100 mA			Differential resistance r_Z (Ω) at I_Z = 100 mA	
	min.	nom.	max.	min.	typ.	max.	typ.	max.
BZZ14	5.5	5.72	6.3	+0.5	+1.6	+3.0	1.47	4.0
BZZ15	5.8	6.3	6.8	+2.0	+2.45	+4.0	1.12	2.5
BZZ16	6.4	6.9	7.4	+2.5	+3.15	+4.0	1.1	2.5
BZZ17	7.2	7.6	8.2	+3.0	+4.05	+5.0	1.2	3.5
BZZ18	7.8	8.35	9.0	+3.0	+4.9	+6.1	1.38	5.0
BZZ19	8.8	9.3	10	+4.0	+6.1	+7.0	1.65	5.0
BZZ20	9.6	10.3	11	+3.0	+7.25	+11	2.05	5.0
BZZ21		11.3			+9.5		2.0	8.0
BZZ22		12.3			+11		2.5	10
BZZ23		13.4			+12		3.0	13
BZZ24		15.5			+14.8		4.2	16
BZZ25		16.7			+16		5.0	20
BZZ26		18.8			+18.7		7.0	20
BZZ27		21.5			+21.2		9.2	20
BZZ28		23.6			+23.8		12.2	25
BZZ29		26.1			+26.5		16	28

	at I_Z = 500 mA			at I_Z = 500 mA			at I_Z = 500 mA	
	min.	nom.	max.	min.	typ.	max.	typ.	max.
BZZ14	5.5	5.97	6.5	0	+2.15	+3.0	0.54	1.0
BZZ15	6.0	6.6	7.4	+1.5	+2.9	+4.0	0.53	2.0
BZZ16	6.6	7.12	7.9	+2.5	+3.7	+4.0	0.57	2.5
BZZ17	7.1	7.82	8.5	+3.0	+4.6	+7.0	0.62	3.0
BZZ18	8.0	8.57	9.5	+3.5	+5.5	+6.8	0.68	3.0
BZZ19	8.8	9.55	10.2	+4.5	+6.65	+7.5	0.81	3.0
BZZ20	10	10.72	11.6	+3.0	+7.8	+11	0.97	3.0

LOW POWER VOLTAGE REGULATORS

These types have been superseded by

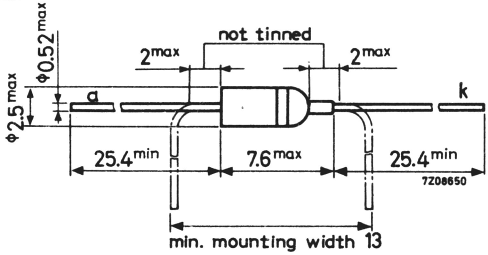
the BZY88-C4V7 to BZY88-C9V1

VOLTAGE REGULATOR DIODES

Silicon alloyed diodes in subminiature all glass DO-7 envelope for use as low power voltage stabilisers or voltage references.
The series consists of 12 types with nominal zener voltages ranging from 3.9 to 12 V with a tolerance of ±5%.

MECHANICAL DATA Dimensions in mm

DO-7


$\phi 0.52^{max}$
not tinned
2^{max}
2^{max}
$\phi 2.5^{max}$
a
k
25.4^{min}
7.6^{max}
25.4^{min}
7Z08650
min. mounting width 13

The coloured band indicates the cathode

RATINGS (Limiting values) [1]

Currents				
Repetitive peak zener current	I_{ZRM}	max.	250	mA
Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	250	mA
Power dissipation				
Total power dissipation up to T_{amb} = 50 °C	P_{tot}	max.	400	mW
Temperatures				
Storage temperature	T_{stg}		-65 to +175	°C
Junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.31	°C/mW

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[1] Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Forward voltage at I_F = 10 mA V_F < 900 mV

	Zener voltage[1]			Temperature coefficient[1]	Differential resistance[1]	Reverse current at V_R = 1.0 V	
	at I_Z = 20 mA			at I_Z = 20 mA	at I_Z = 20 mA	T_{amb} =	
	min.	nom.	max.	typ.	max.	25 °C	150 °C
1N748A	3.705	3.9	4.095 V	-1.90 mV/°C	23 Ω	10	30 μA
1N749A	4.085	4.3	4.515 V	-1.55 mV/°C	22 Ω	2.0	30 μA
1N750A	4.465	4.7	4.935 V	-0.845 mV/°C	19 Ω	2.0	30 μA
1N751A	4.845	5.1	5.355 V	-0.405 mV/°C	17 Ω	1.0	20 μA
1N752A	5.320	5.6	5.880 V	+0.336 mV/°C	11 Ω	1.0	20 μA
1N753A	5.890	6.2	6.510 V	+1.36 mV/°C	7.0 Ω	0.1	20 μA
1N754A	6.460	6.8	7.140 V	+2.38 mV/°C	5.0 Ω	0.1	20 μA
1N755A	7.125	7.5	7.875 V	+3.37 mV/°C	6.0 Ω	0.1	20 μA
1N756A	7.790	8.2	8.610 V	+4.26 mV/°C	8.0 Ω	0.1	20 μA
1N757A	8.645	9.1	9.555 V	+5.10 mV/°C	10 Ω	0.1	20 μA
1N758A	9.500	10.0	10.500 V	+6.0 mV/°C	17 Ω	0.1	20 μA
1N759A	11.400	12.0	12.000 V	+7.2 mV/°C	30 Ω	0.1	20 μA

OPERATING NOTES

1. When using a soldering iron, the diodes may be soldered directly into a circuit, but heat conducted to the junction should be kept to a minimum by use of a thermal shunt.

2. Diodes may be dip soldered at a solder temperature of 245 °C for a maximum soldering time of 5 seconds. The case temperature during dip soldering must not at any time exceed the maximum storage temperature. These recommendations apply to a diode with the anode end mounted flush on the board with punched-through holes. For mounting the cathode end onto the board the diode must be spaced 5 mm from the underside of the printed circuit board in the case of punched-through holes or 5 mm from the top of the board for plated-through holes.

3. Care should be taken not to bend the leads nearer than 1.5 mm from the seals.

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[1]) Measured by a pulse method with $t_p \leq 100\ \mu s$, $\delta = 0.001$, T_j = 25 °C.

VOLTAGE REFERENCE DIODES

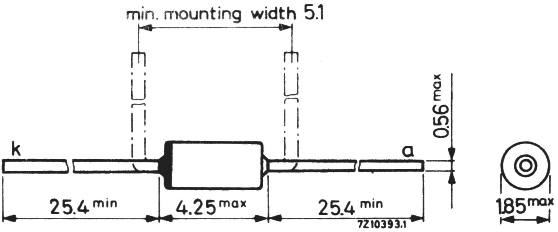
Silicon planar diodes in a DO-35 envelope intended for use as low power voltage stabilizers or voltage references.
The series consists of 29 types with nominal zener voltages ranging from 5.1 V to 75 V with a tolerance of ± 5 %.

QUICK REFERENCE DATA				
Zener voltage range		nom.	5.1 to 75	V
Zener voltage tolerance			±5	%
Total power dissipation up to $T_{amb} = 50\ ^oC$	P_{tot}	max.	400	mW
Non-repetitive peak reverse power $t = 100\ \mu s$; $T_j = 150\ ^oC$	P_{ZSM}	max.	30	W
Junction temperature	T_j	max.	200	^oC
Thermal resistance from junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.38	$^oC/mW$

MECHANICAL DATA

Dimensions in mm

DO-35



Cathode indicated by coloured mark or by broad band if colour coded (see General Section)

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Currents

Steady-state regulator current at T_{amb} = 25 °C					Non-repetitive peak reverse current			
1N5729B	I_Z	max.	65	mA	I_{ZSM}	max.	2.90	A
1N5730B	I_Z	max.	60	mA	I_{ZSM}	max.	2.60	A
1N5731B	I_Z	max.	55	mA	I_{ZSM}	max.	2.40	A
1N5732B	I_Z	max.	50	mA	I_{ZSM}	max.	2.30	A
1N5733B	I_Z	max.	45	mA	I_{ZSM}	max.	2.10	A
1N5734B	I_Z	max.	40	mA	I_{ZSM}	max.	1.95	A
1N5735B	I_Z	max.	40	mA	I_{ZSM}	max.	1.80	A
1N5736B	I_Z	max.	35	mA	I_{ZSM}	max.	1.65	A
1N5737B	I_Z	max.	30	mA	I_{ZSM}	max.	1.50	A
1N5738B	I_Z	max.	30	mA	I_{ZSM}	max.	1.40	A
1N5739B	I_Z	max.	25	mA	I_{ZSM}	max.	1.28	A
1N5740B	I_Z	max.	25	mA	I_{ZSM}	max.	1.20	A
1N5741B	I_Z	max.	20	mA	I_{ZSM}	max.	1.13	A
1N5742B	I_Z	max.	20	mA	I_{ZSM}	max.	1.05	A
1N5743B	I_Z	max.	15	mA	I_{ZSM}	max.	0.98	A
1N5744B	I_Z	max.	15	mA	I_{ZSM}	max.	0.90	A
1N5745B	I_Z	max.	15	mA	I_{ZSM}	max.	0.83	A
1N5746B	I_Z	max.	10	mA	I_{ZSM}	max.	0.75	A
1N5747B	I_Z	max.	10	mA	I_{ZSM}	max.	0.68	A
1N5748B	I_Z	max.	10	mA	I_{ZSM}	max.	0.64	A
1N5749B	I_Z	max.	10	mA	I_{ZSM}	max.	0.60	A
1N5750B	I_Z	max.	9	mA	I_{ZSM}	max.	0.57	A
1N5751B	I_Z	max.	9	mA	I_{ZSM}	max.	0.53	A
1N5752B	I_Z	max.	8	mA	I_{ZSM}	max.	0.49	A
1N5753B	I_Z	max.	7	mA	I_{ZSM}	max.	0.45	A
1N5754B	I_Z	max.	6	mA	I_{ZSM}	max.	0.42	A
1N5755B	I_Z	max.	6	mA	I_{ZSM}	max.	0.38	A
1N5756B	I_Z	max.	5	mA	I_{ZSM}	max.	0.34	A
1N5757B	I_Z	max.	5	mA	I_{ZSM}	max.	0.30	A

Power dissipation

Total power dissipation up to T_{amb} = 50 °C	P_{tot}	max.	400	mW
Non-repetitive peak reverse power $t = 100\ \mu s$; T_j = 150 °C; square wave	P_{ZSM}	max.	30	W

Temperatures

Storage temperature	T_{stg}		−65 to +200	°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air at maximum lead length	$R_{th\ j\text{-}a} =$	0.38 °C/mW

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Forward voltage

I_F = 10 mA; T_{amb} = 25 °C	V_F	<	0.9	V

Reverse current

1N5729B	V_R = 2 V	I_R	<	2000	nA
1N5730B	V_R = 2 V	I_R	<	1000	nA
1N5731B	V_R = 4 V	I_R	<	3000	nA
1N5732B	V_R = 4 V	I_R	<	2000	nA
1N5733B	V_R = 5 V	I_R	<	1000	nA
1N5734B	V_R = 5 V	I_R	<	700	nA
1N5735B	V_R = 6 V	I_R	<	500	nA
1N5736B	V_R = 7 V	I_R	<	200	nA
1N5737B	V_R = 8 V	I_R	<	100	nA
1N5738B to 1N5757B	V_R = 0.7 x V_{Znom}	I_R	<	50	nA

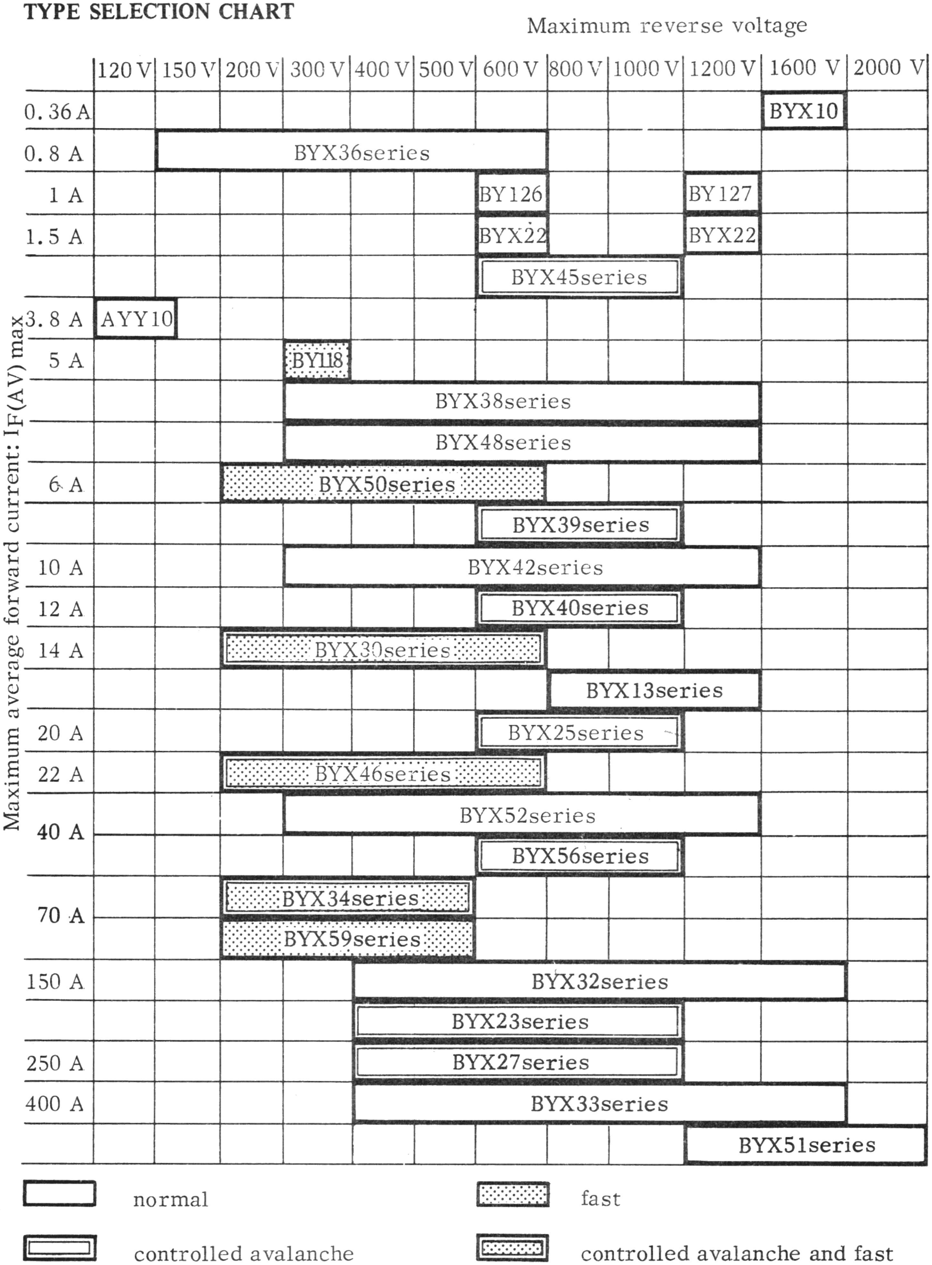
CHARACTERISTICS (continued)

T_j = 25 °C unless otherwise specified

	Zener voltage V_Z at I_Z = 10 mA ± 5 % see General Section	Temperature coefficient S_Z at I_Z = 10 mA	Differential impedance z_Z at I_Z = 10 mA; I_Z = 0.2 mA f = 1 kHz
	nom.	typ.	max.
1N5729B	5.1 V	−0.2 mV/°C	50 Ω
1N5730B	5.6 V	+1.2 mV/°C	25 Ω
1N5731B	6.2 V	+2.3 mV/°C	10 Ω
1N5732B	6.8 V	+3.0 mV/°C	10 Ω
1N5733B	7.5 V	+4.0 mV/°C	10 Ω
1N5734B	8.2 V	+5.0 mV/°C	15 Ω
1N5735B	9.1 V	+6.0 mV/°C	15 Ω
1N5736B	10.0 V	+7.0 mV/°C	20 Ω
	at I_Z = 5 mA	at I_Z = 5 mA	
1N5737B	11.0 V	+8.0 mV/°C	20 Ω
1N5738B	12.0 V	+9.0 mV/°C	25 Ω
1N5739B	13.0 V	+10.5 mV/°C	30 Ω
1N5740B	15.0 V	+12.5 mV/°C	30 Ω
1N5741B	16.0 V	+13.0 mV/°C	40 Ω
1N5742B	18.0 V	+15.0 mV/°C	45 Ω
1N5743B	20.0 V	+17.0 mV/°C	55 Ω
1N5744B	22.0 V	+19.0 mV/°C	55 Ω
1N5745B	24.0 V	+21.0 mV/°C	70 Ω
	at I_Z = 2 mA	at I_Z = 2 mA	
1N5746B	27.0 V	+23.5 mV/°C	80 Ω
1N5747B	30.0 V	+26 mV/°C	80 Ω
1N5748B	33.0 V	+29 mV/°C	90 Ω
1N5749B	36.0 V	+31 mV/°C	90 Ω
1N5750B	39.0 V	+34 mV/°C	130 Ω
1N5751B	43.0 V	+37 mV/°C	150 Ω
1N5752B	47.0 V	+40 mV/°C	170 Ω
1N5753B	51.0 V	+44 mV/°C	180 Ω
1N5754B	56.0 V	+47 mV/°C	200 Ω
1N5755B	62.0 V	+51 mV/°C	215 Ω
1N5756B	68.0 V	+56 mV/°C	240 Ω
1N5757B	75.0 V	+60 mV/°C	255 Ω

Rectifier diodes

TYPE SELECTION CHART



Maximum average forward current: $I_{F(AV)}$max	Maximum reverse voltage					
	1.8 kV	10 kV	15 kV	35 kV	37.5 kV	75 kV to 150 kV
2.0 mA	BY184					
2.5 mA		BY187	BY176	BY185		
50 mA					BYX35	BYX29series

Single phase bridge rectifier assemblies

Average output current I_O	Maximum imput voltage (r.m.s.)	
	60 V	280 V
1 A		BY179
1.4 A	BY164	

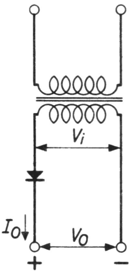
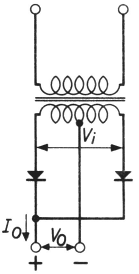
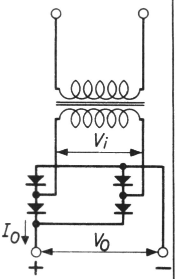
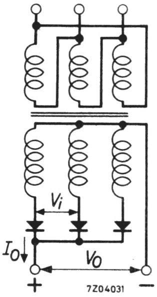
□ normal

▣ controlled avalanche

░ fast

OPERATION AS RECTIFIER

Output voltages and currents of diodes in rectifier circuits based on the rated crest working reverse voltage and rated average forward current.

		Single phase half wave	Two phase half wave	Single phase full wave (Single phase bridge)	Three phase half wave (Three phase star)
					
		$I_O = I_{F(AV)}$	$I_O = 2\ I_{F(AV)}$	$I_O = 2\ I_{F(AV)}$	$I_O = 3\ I_{F(AV)}$
V_{RWMmax}	$V_{i(rms)}$	V_O	V_O	V_O	V_O
100	70	30	30	62	47
200	140	60	60	125	95
300	210	90	90	185	140
400	280	125	125	250	190
500	350	155	155	310	235
600	420	185	185	375	280
800	560	250	250	500	380
1000	700	315	315	635	475
1200	840	375	375	750	560
1600	1120	500	500	1000	760

These V_i and I_O figures are absolute max. values for resistive or inductive load; no source impedance is assumed. The equipment designer has to determine an average design such that these values will not be exceeded.

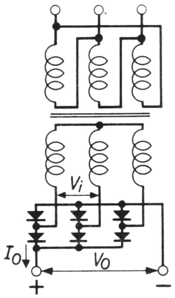
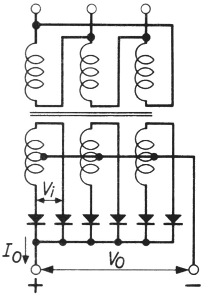
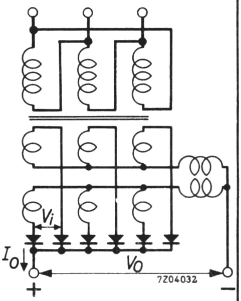
$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

I_O = average output current in A

V_O = average output voltage in V

OPERATION AS RECTIFIER

Output voltages and currents of diodes in rectifier circuits based on the rated crest working reverse voltage and rated average forward current.

		Three phase full wave (Three phase bridge)	Six phase half wave (Six phase star)	Three phase double Y with interphase transformer
				
		$I_O = 3\ I_{F(AV)}$	$I_O = 4.8\ I_{F(AV)}$	$I_O = 6\ I_{F(AV)}$
V_{RWMmax}	$V_{i(rms)}$	V_O	V_O	V_O
100	70	94	47	40
200	140	185	95	80
300	210	280	140	120
400	280	375	190	160
500	350	470	235	200
600	420	565	280	240
800	560	750	380	320
1000	700	940	475	400
1200	840	1120	560	480
1600	1120	1510	760	640

These V_i and I_O figures are absolute max. values for resistive or inductive load; no source impedance is assumed. The equipment designer has to determine an average design such that these values will not be exceeded.

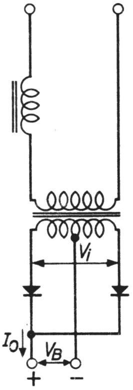
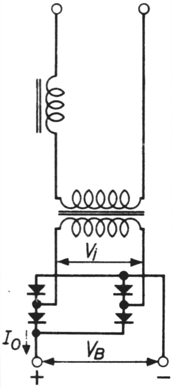
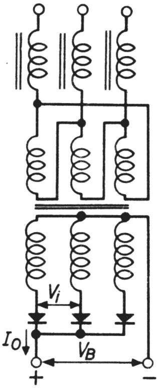
$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

I_O = average output current in A

V_O = average output voltage in V

TYPICAL OPERATION FOR BATTERY CHARGING

Output voltages and currents of diodes in rectifier circuits based on the rated crest working reverse voltage and rated average forward current.

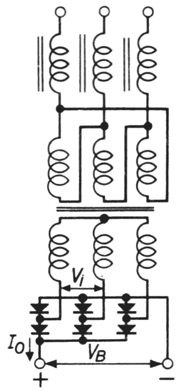
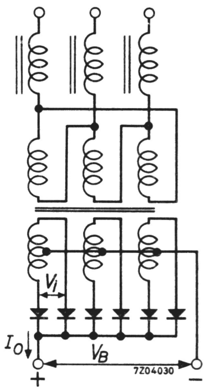
		Two phase half wave		Single phase full wave (Single phase bridge)		Three phase half wave (Three phase star)	
							
		$I_O = I_{F(AV)}$		$I_O = I_{F(AV)}$		$I_O = 1.5\ I_{F(AV)}$	
V_{RWMmax}	$V_{i(rms)}$	V_O	n	V_O	n	V_O	n
100	62	28	13	60	27	35	16
200	125	60	27	120	54	70	32
300	190	90	41	180	82	105	47
400	255	120	54	240	109	140	64
500	315	150	68	300	136	170	77
600	380	180	82	360	164	210	95
800	510	240	109	480	217	270	122
1000	640	300	136	600	272	340	154
1200	750	360	164	720	328	420	190

The above data are nominal values with battery load. The possibility of mains voltage fluctuations of max. 10% has been taken into account. For current limiting use is made of inductors in series with the primary of the mains transformer.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V
I_O = average output current in A
V_B = battery voltage in V
n = maximum number of Pb cells in series (nominal voltage per cell is 2.2 V)

TYPICAL OPERATION FOR BATTERY CHARGING

Output voltages and currents of diodes in rectifier circuits based on the rated crest working reverse voltage and rated average forward current.

		Three phase full wave (Three phase bridge)		Six phase half wave (Six phase star)	
					
		$I_O = 1,5\ I_{F(AV)}$		$I_O = 3\ I_{F(AV)}$	
V_{RWMmax}	$V_{i(rms)}$	V_O	n	V_O	n
100	62	60	27	30	13
200	125	120	54	60	27
300	190	180	82	90	41
400	255	240	109	120	54
500	315	300	136	150	68
600	380	360	164	180	82
800	510	480	217	240	109
1000	640	600	272	300	136
1200	750	720	328	360	164

The above data are nominal values with battery load. The possibility of mains voltage fluctuations of max. 10% has been taken into account. For current limiting use is made of inductors in series with the primary of the mains transformer.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V
I_O = average output current in A
V_B = battery voltage in V
n = maximum number of Pb cells in series (nominal voltage per cell is 2.2 V)

OPERATING NOTES

When there is a possibility that transients, due to the energy stored in the transformer, will exceed the maximum permissible non-repetitive peak reverse voltage [1]), a damping circuit should be connected across the transformer.
Either a series RC circuit or a voltage dependent resistor may be used.
Suitable component values for an RC circuit across the transformer primary or secondary may be calculated as follows:

$\frac{V_{RSM}}{V_{RWM}}$	RC across primary of transformer		RC across secondary of transformer	
	C (μF)	R (Ω)	C (μF)	R (Ω)
2.0	$200\frac{I_{mag}}{V_1}$	$\frac{150}{C}$	$225\frac{I_{mag}T^2}{V_1}$	$\frac{200}{C}$
1.5	$400\frac{I_{mag}}{V_1}$	$\frac{225}{C}$	$450\frac{I_{mag}T^2}{V_1}$	$\frac{275}{C}$
1.25	$550\frac{I_{mag}}{V_1}$	$\frac{260}{C}$	$620\frac{I_{mag}T^2}{V_1}$	$\frac{310}{C}$
1.0	$800\frac{I_{mag}}{V_1}$	$\frac{300}{C}$	$900\frac{I_{mag}T^2}{V_1}$	$\frac{350}{C}$

where I_{mag} = magnetising primary r.m.s. current (A)
V_1 = transformer primary r.m.s. voltage (V)
V_2 = transformer secondary r.m.s. voltage (V)
$T = V_1/V_2$
V_{RSM} = the transient voltage peak produced by the transformer
V_{RWM} = the actually applied crest working reverse voltage

The capacitance values calculated from the above table are minimum values; to allow for circuit variations and component tolerances, larger values should be used.

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[1]) For controlled avalanche types read: non-repetitive peak reverse power.

GERMANIUM RECTIFIER DIODE

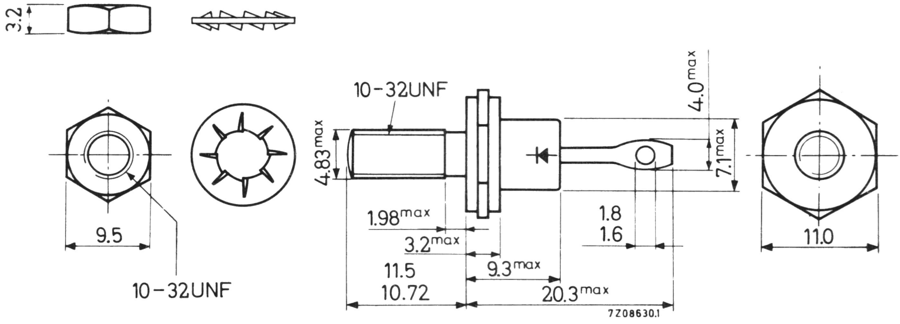
Germanium diode in a DO-4 metal envelope, primarily intended for medium-power rectifier applications.

QUICK REFERENCE DATA				
Crest working reverse voltage	V_{RWM}	max.	95	V
Repetitive peak reverse voltage	V_{RRM}	max.	120	V
Average forward current	$I_{F(AV)}$	max.	3.8	A
Non-repetitive peak forward current ($t < 10$ ms)	I_{FSM}	max.	90	A
Junction temperature	T_j	max.	75	°C

MECHANICAL DATA

Dimensions in mm

DO-4


3.2
10-32UNF
4.83max
4.0max
7.1max
1.98max
3.2max
11.5
10.72
9.3max
20.3max
1.8
1.6
9.5
10-32UNF
11.0
7Z08630.1

Net weight: 6.5 g

Diameter of clearance hole: max. 5.2 mm

Accessories supplied on request: 56295 (56262A)

Torque on nut: min. 8 kg cm
(0.8 Newton-metres)
max. 17 kg cm
(1.7 Newton-metres)

All information applies to frequencies up to 1000 Hz

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

Continuous reverse voltage	V_R	max.	85	V
Crest working reverse voltage	V_{RWM}	max.	95	V
Repetitive peak reverse voltage ($\delta \leq 0.01$)	V_{RRM}	max.	120	V
Non-repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	120	V

Currents

Average forward current (averaged over any 20 ms period)	$I_{F(AV)}$	max.	3.8	A
Forward current (d.c.)	I_F	max.	12	A
Repetitive peak forward current	I_{FRM}	max.	12	A
Non-repetitive peak forward current ($t = 10$ ms; half sine wave) $T_j = 75^\circ$C prior to surge	I_{FSM}	max.	90	A

TEMPERATURES

Storage temperature	T_{stg}		−25 to +75	°C
Junction temperature	T_j	max.	75	°C

THERMAL RESISTANCE

From junction to ambient [1]	$R_{th\ j\text{-}a}$	=	65	°C/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	5	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	1	°C/W

CHARACTERISTICS

Voltages

Forward voltage at $I_F = 12$ A; $T_j = 25$ °C	V_F	<	0.70	V
$T_j = 75$ °C	V_F	<	0.65	V

Currents

Reverse current

$V_{RM} = V_{RWMmax}$; $T_j = 25$ °C	I_{RM}	<	100	μA
$V_{RM} = V_{RWMmax}$; $T_j = 75$ °C	I_{RM}	<	4	mA

---

1) Length of anode and cathode connectors 40 mm; diam. 1 mm.

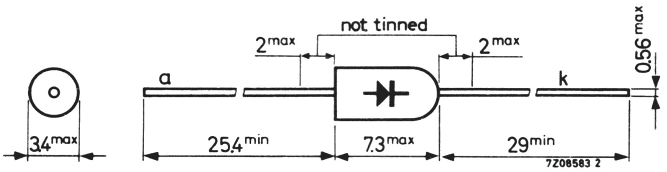
FAST RECOVERY SILICON DIODE

Double diffused general purpose diode in a DO-14 plastic envelope for use as line phase detector, scan rectifier for the supply of the small signal parts in television receivers and other h.f. power supplies.

QUICK REFERENCE DATA				
Crest working reverse voltage	V_{RWM}	max.	300	V
Repetitive peak reverse voltage	V_{RRM}	max.	350	V
Average forward current with R load $V_{RWM} = V_{RWMmax}$	$I_{F(AV)}$	max.	0.4	A
$V_{RWM} = 80$ V	$I_{F(AV)}$	max.	0.5	A
Non-repetitive peak forward current $t = 10$ ms; $T_j = 125\,^{o}C$ prior to surge	I_{FSM}	max.	15	A
Junction temperature	T_j	max.	150	^{o}C
Reverse recovery charge when switched from $I_F = 10$ mA to $V_R = 2$ V with $-dI/dt = 5$ mA/μs; $T_j = 25\,^{o}C$	Q_s	<	0.8	nC

MECHANICAL DATA Dimensions in mm

DO-14



The sealing of the plastic envelope withstands the accelerated damp heat test of IEC recommendation 68 - 2 (test D, severity IV, 6 cycles).

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

Crest working reverse voltage	V_{RWM}	max.	300	V
Repetitive peak reverse voltage ($\delta \leq 0.01$)	V_{RRM}	max.	350	V
Non-repetitive peak reverse voltage ($t \leq 10\,ms$)	V_{RSM}	max.	350	V

Currents

Average forward current (averaged over any 20 ms period) with R load $V_{RWM} = V_{RWMmax}$	$I_{F(AV)}$	max.	0.4	A
$V_{RWM} = 80\,V$	$I_{F(AV)}$	max.	0.5	A
Repetitive peak forward current	I_{FRM}	max.	3.0	A
Repetitive peak forward current($\delta \leq 0.03$; $f \geq 15\,kHz$)	I_{FRM}	max.	5.0	A
Non-repetitive peak forward current ($t = 10\,ms$; half sine wave) $T_j = 125\,^oC$ prior to surge	I_{FSM}	max.	15	A
Repetitive peak reverse current	I_{RRM}	max.	0.5	A

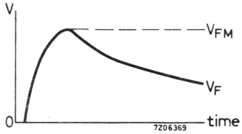
Temperatures

Storage temperature	T_{stg}		-65 to +125	^oC
Junction temperature	T_j	max.	150	^oC

THERMAL RESISTANCE See page 3

CHARACTERISTICS

Forward voltage				
$I_F = 2\,A$; $T_j = 150\,^oC$	V_F	<	1.5	V 1)
Peak reverse current				
$V_{RM} = 300\,V$; $T_j = 125\,^oC$	I_{RM}	<	200	μA
Capacitance at $f = 1\,MHz$				
$V_R = 150\,V$; $T_j = 25$ to $125\,^oC$	C_d	typ.	4.0	pF
Forward recovery voltage				
$I_F = 100\,mA$; $t_r = 50\,ns$	V_{FM}	<	3.0	V



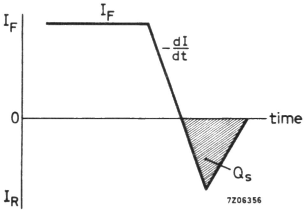
---

1) Measured under pulsed conditions to avoid excessive dissipation.

CHARACTERISTICS (continued)

Reverse recovery charge when switched from.

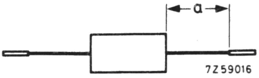
I_F = 10 mA to V_R = 2 V with
$-\frac{dI}{dt}$ = 5 mA/µs; T_j = 25 °C $\quad Q_s < 0.8$ nC



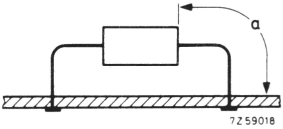
THERMAL RESISTANCE

Effect of mounting on thermal resistance $R_{th\ j-a}$

The quoted values apply when no other leads run to the tie-points. If leads of other dissipating components share the same tie-points, the thermal resistance will be higher than that quoted.

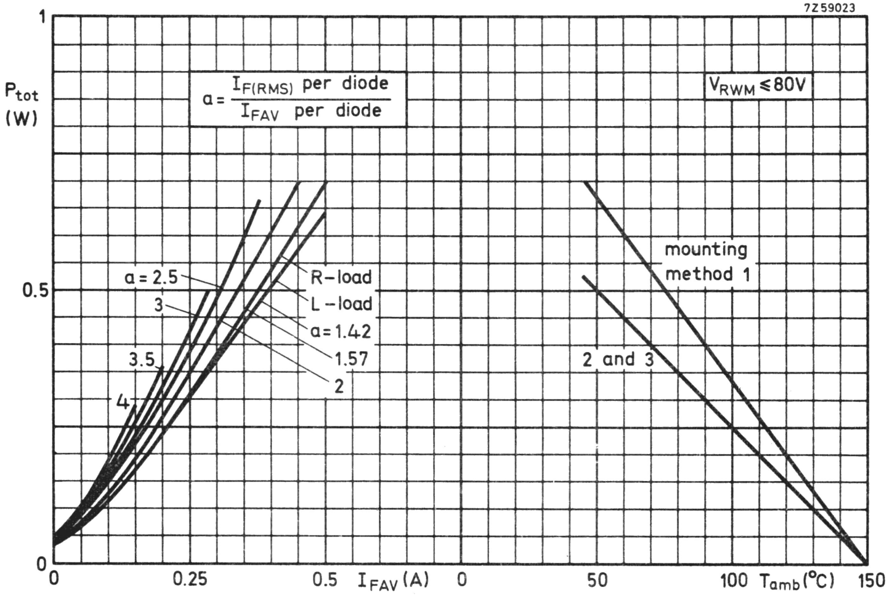


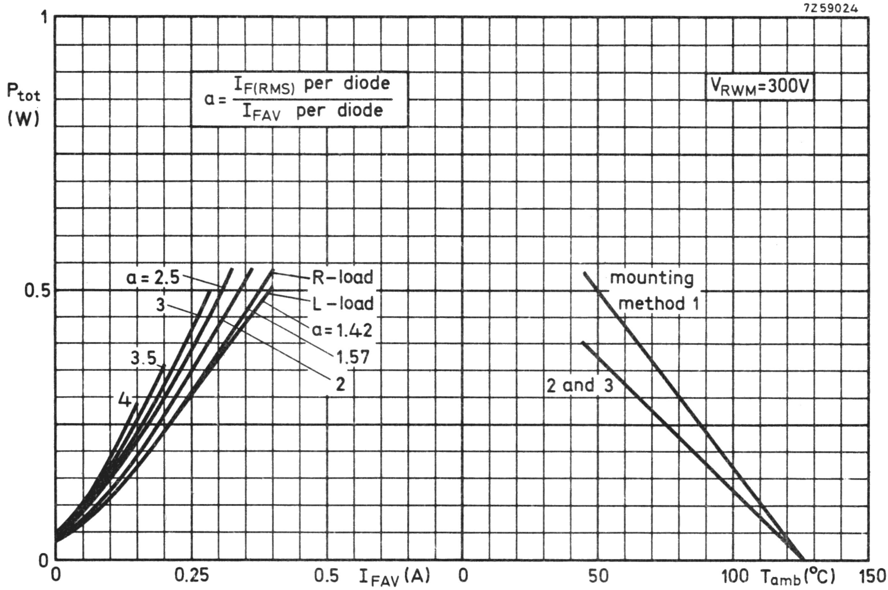
1. Mounted to solder tags at a lead-length a = 10 mm. $R_{th\ j-a}$ = 150 °C/W
2. Mounted to solder tags at a = maximum lead-length. $R_{th\ j-a}$ = 200 °C/W
3. Mounted on printed-wiring board with a small area of copper at a lead-length a > 5 mm. $R_{th\ j-a}$ = 200 °C/W



SOLDERING AND MOUNTING NOTES

1. Soldered joints must be at least 5 mm from the seal.
2. The maximum permissible temperature of the soldering iron or bath is 300 °C; it must be in contact with the joint for no more than 3 seconds.
3. Avoid hot spots due to handling or mounting; the body of the device must not come into contact with or be exposed to a temperature higher than 125°C.


7Z59023
P_{tot} (W)
1
0.5
0
$a = \frac{I_{F(RMS)} \text{ per diode}}{I_{FAV} \text{ per diode}}$
$V_{RWM} \leq 80V$
a = 2.5
3
3.5
4
R-load
L-load
a = 1.42
1.57
2
mounting method 1
2 and 3
0
0.25
0.5
I_{FAV} (A)
0
50
100
T_{amb} (°C)
150

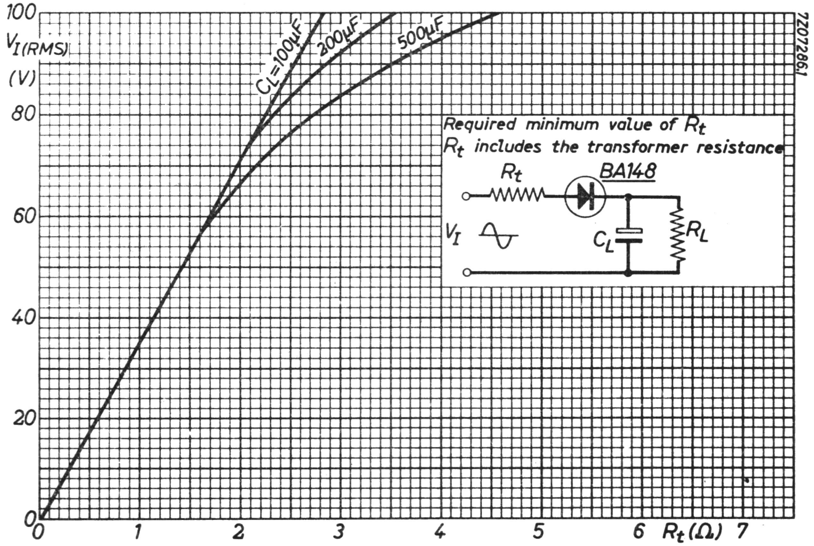

7Z59024
P_{tot} (W)
1
0.5
0
$a = \frac{I_{F(RMS)} \text{ per diode}}{I_{FAV} \text{ per diode}}$
$V_{RWM} = 300V$
a = 2.5
3
3.5
4
R-load
L-load
a = 1.42
1.57
2
mounting method 1
2 and 3
0
0.25
0.5
I_{FAV} (A)
0
50
100
T_{amb} (°C)
150

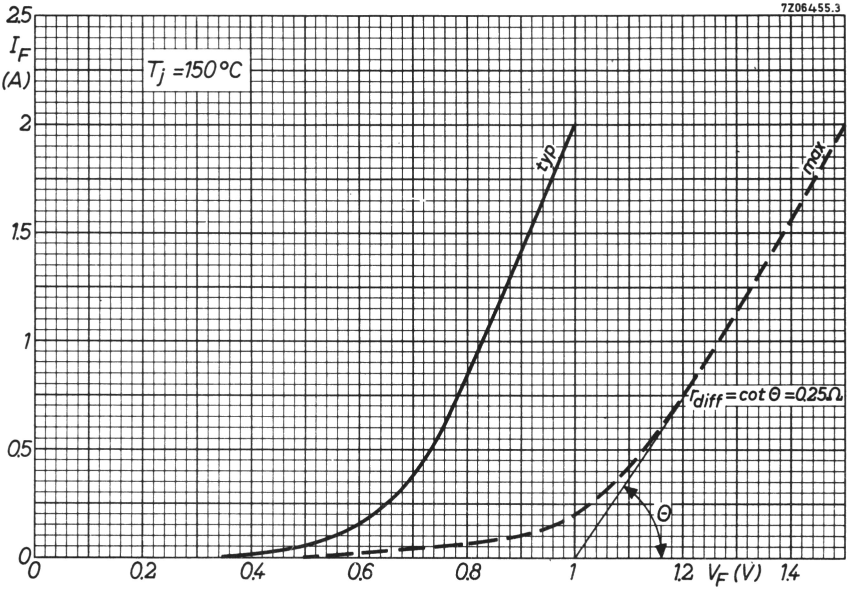
From the left hand graph the total power dissipation can be found as a function of the forward current.

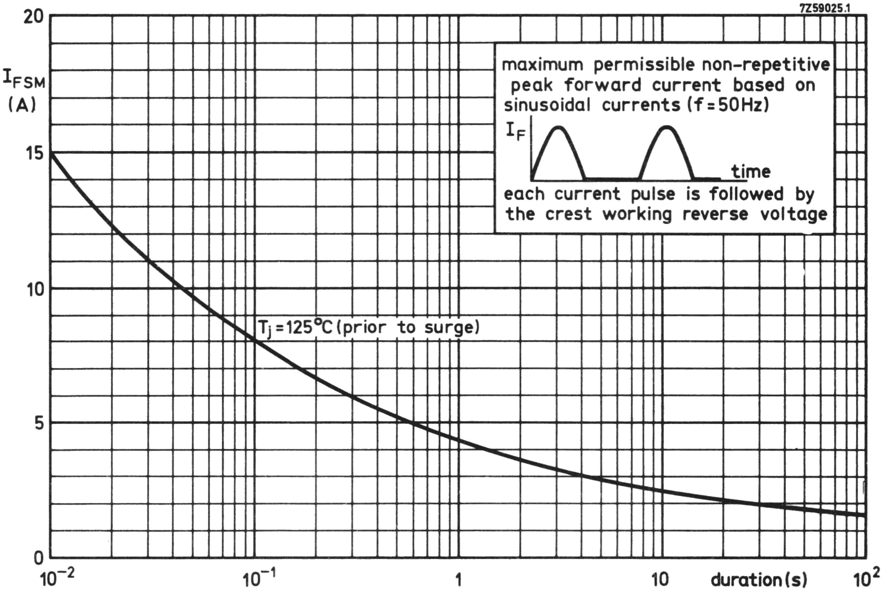
The parameter $a = \dfrac{I_{F(RMS)} \text{ per diode}}{I_{FAV} \text{ per diode}}$ depends on $\omega R_L C_L$ and $\dfrac{R_t + r_{diff.}}{R_L}$ and can be found from existing graphs.

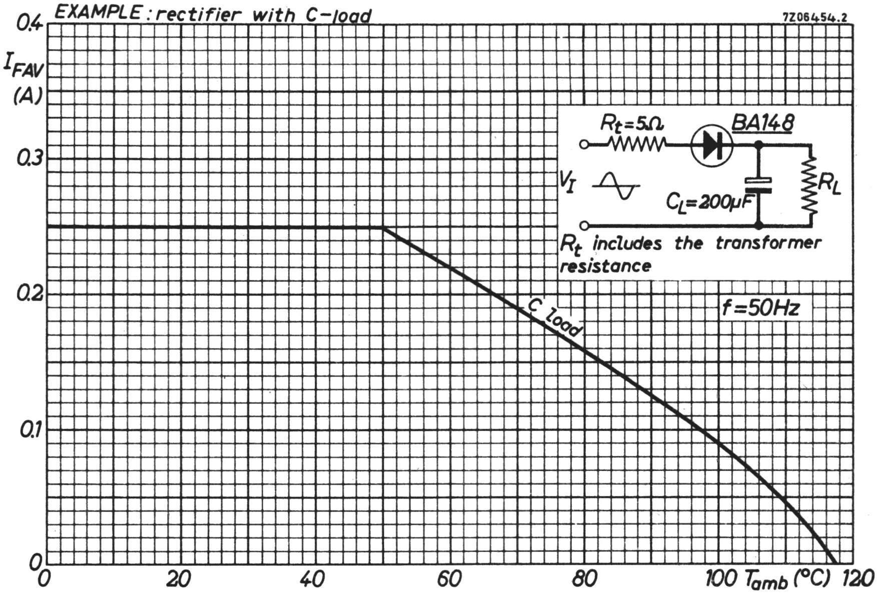
See Application Book: RECTIFIER DIODES
Once the power dissipation is known, the max. permissible ambient temperature follows from the right hand graph.

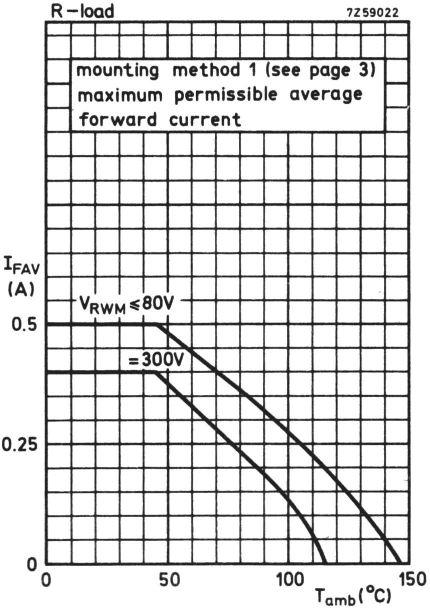
For the series resistance, added to limit the initial peak rectifier current, the required minimum value can be found from the graph below.
rdiff. is shown on page 6, upper figure.

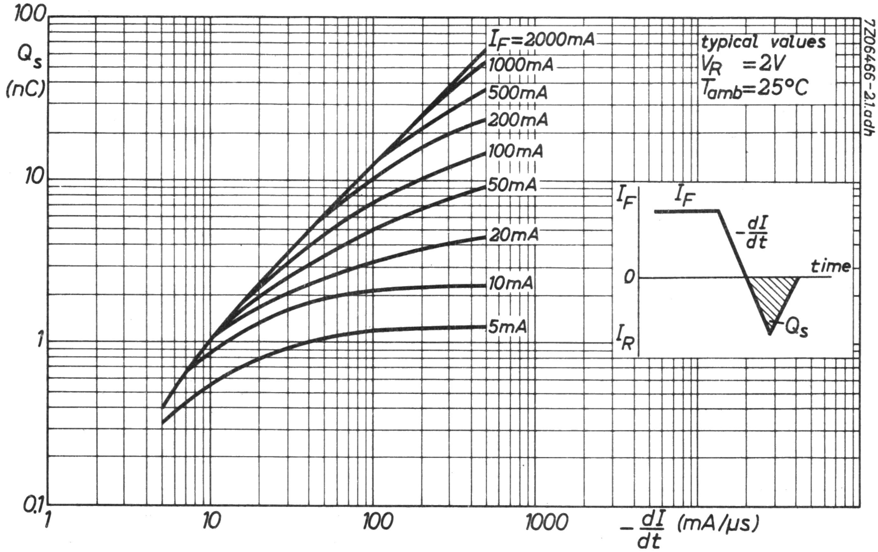


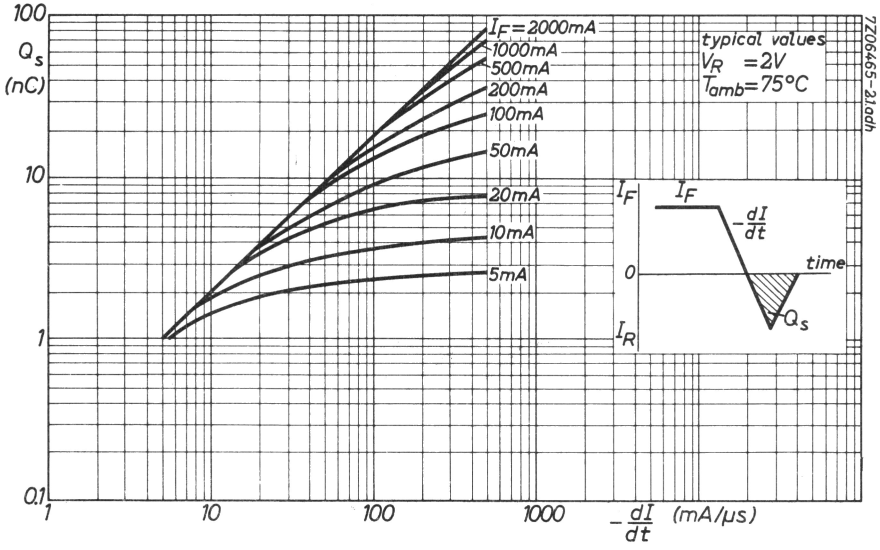

7Z06455.3
I_F (A)
T_j = 150 °C
typ
max
$r_{diff} = \cot\Theta = 0.25\Omega$
Θ
0
0.5
1
1.5
2
2.5
0
0.2
0.4
0.6
0.8
1
1.2
1.4
V_F (V)

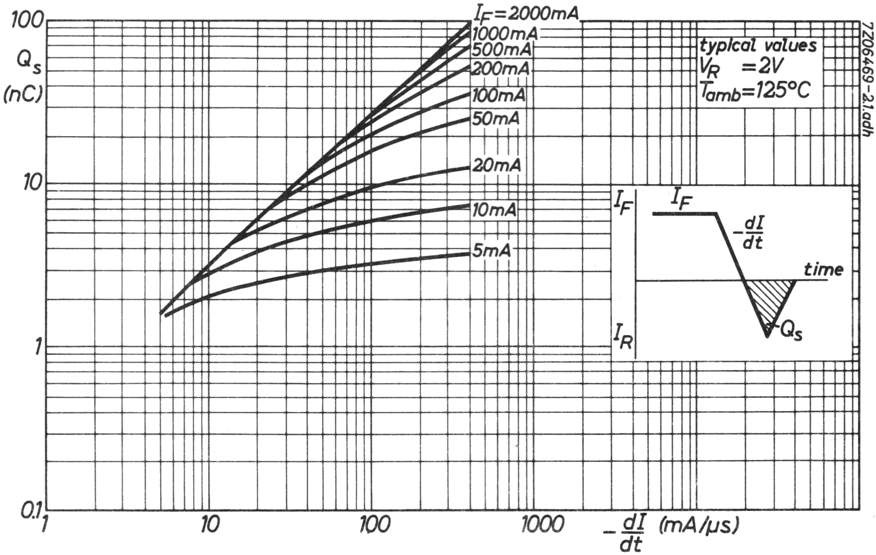

7Z59025.1
I_{FSM} (A)
maximum permissible non-repetitive peak forward current based on sinusoidal currents (f = 50 Hz)
I_F
time
each current pulse is followed by the crest working reverse voltage
T_j = 125 °C (prior to surge)
0
5
10
15
20
10^{-2}
10^{-1}
1
10
10^2
duration (s)

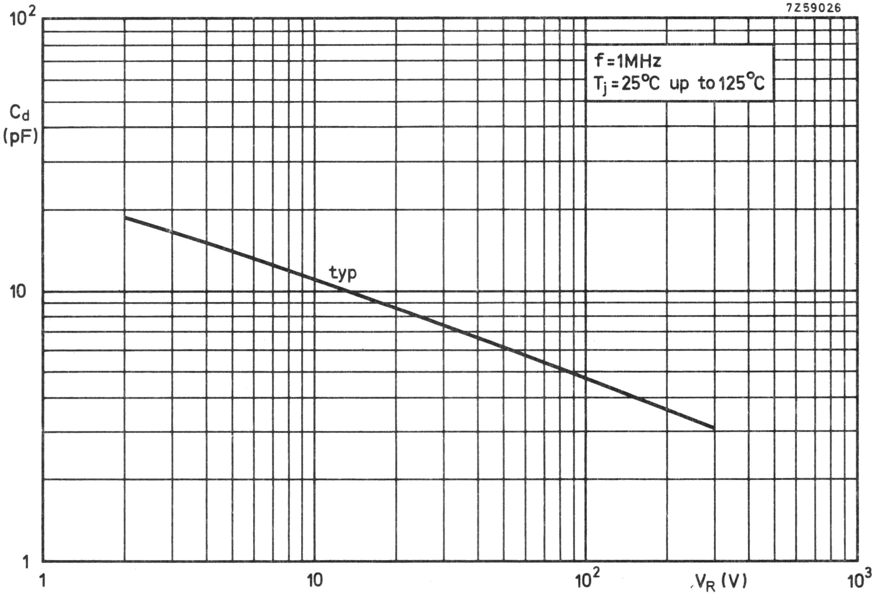

EXAMPLE : rectifier with C-load
7Z06454.2
I_{FAV} (A)
0.4
0.3
0.2
0.1
0
R_t=5Ω
BA148
V_I
C_L=200μF
R_L
R_t includes the transformer resistance
f=50Hz
C load
0
20
40
60
80
100
T_{amb} (°C)
120


R-load
7Z59022
mounting method 1 (see page 3)
maximum permissible average forward current
I_{FAV} (A)
V_{RWM} ≤ 80V
=300V
0.5
0.25
0
0
50
100
150
T_{amb} (°C)


100
Q_s
(nC)
10
1
0.1
1
10
100
1000
$-\frac{dI}{dt}$ (mA/µs)
I_F=2000mA
1000mA
500mA
200mA
100mA
50mA
20mA
10mA
5mA
typical values
V_R =2V
T_{amb}=25°C
I_F
I_F
$-\frac{dI}{dt}$
0
time
I_R
Q_s
7Z06466-2.1.adh

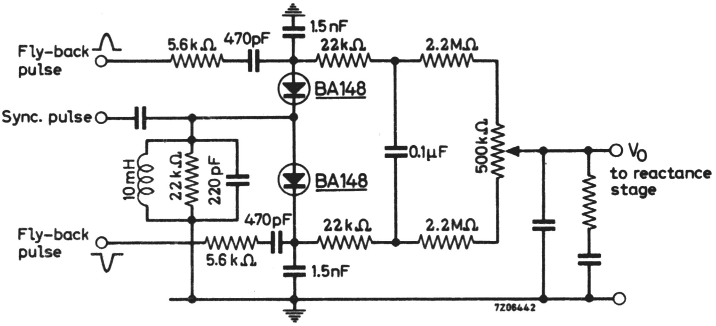

100
Q_s
(nC)
10
1
0.1
1
10
100
1000
$-\frac{dI}{dt}$ (mA/µs)
I_F=2000mA
1000mA
500mA
200mA
100mA
50mA
20mA
10mA
5mA
typical values
V_R =2V
T_{amb}=75°C
I_F
I_F
$-\frac{dI}{dt}$
0
time
I_R
Q_s
7Z06465-2.1.adh


100
Q_s
(nC)
10
1
0.1
1
10
100
1000
-dI/dt (mA/µs)
I_F=2000mA
1000mA
500mA
200mA
100mA
50mA
20mA
10mA
5mA
typical values
V_R = 2V
T_amb=125°C
7Z06469-2.1.adh
I_F
I_F
-dI/dt
time
I_R
Q_s


7Z59026
10^2
C_d
(pF)
10
1
f = 1MHz
T_j = 25°C up to 125°C
typ
1
10
10^2
V_R (V)
10^3

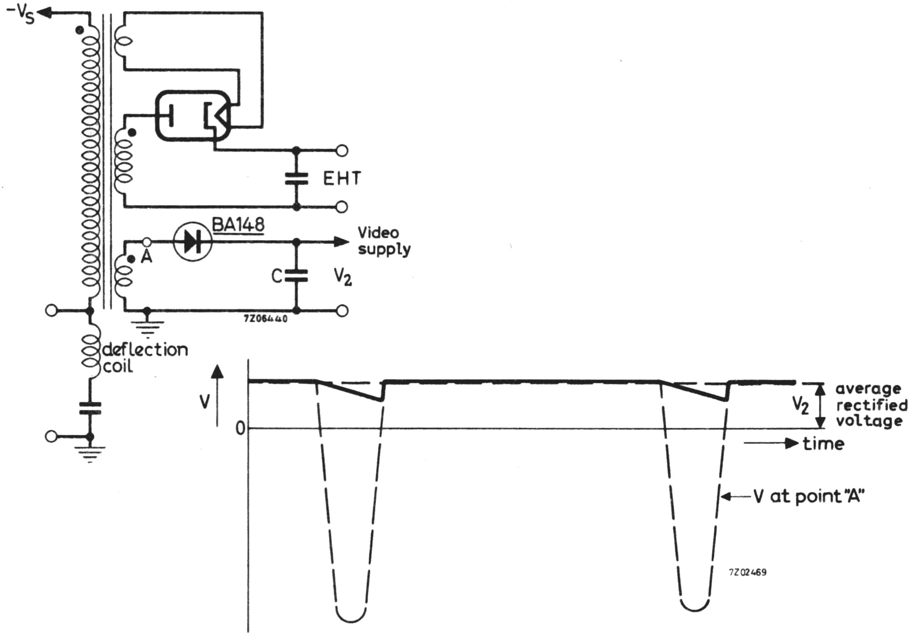
APPLICATION INFORMATION

Self catching line phase detector


Fly-back pulse
5.6 kΩ
470pF
1.5 nF
22kΩ
2.2MΩ
BA148
Sync. pulse
10mH
22 kΩ
220 pF
0.1μF
500kΩ
BA148
V_O
to reactance stage
Fly-back pulse
470pF
22kΩ
2.2MΩ
5.6 kΩ
1.5nF
7Z06442

The high speed and low leakage current of the BA148 make it particularly useful in the type of line phase detector shown above.

Low voltage supply from the line output stage of a television receiver.


$-V_S$
EHT
BA148
A
Video supply
C
V_2
7Z06440
deflection coil
V
0
V_2
average rectified voltage
time
V at point "A"
7Z02469

An extra winding on the line output transformer in series with a BA148 can supply up to 30 V for the low voltage parts of a television receiver. Because the diode conducts during scan the source impedance is low and the output voltage stable.

SILICON DIODE

Silicon diffused rectifier diode in a metal envelope for use as efficiency diode in line deflection circuits of television receivers.

RATINGS (Limiting values) [1]

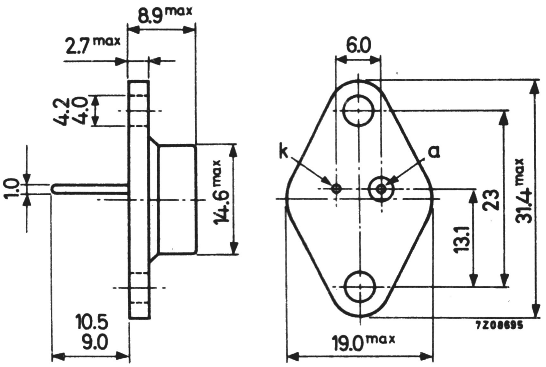
Voltage				
Repetitive peak reverse voltage	V_{RRM}	max.	300	V
Currents				
Forward current (d.c.)	I_F	max.	6	A
Average **rectified** forward current (averaged over any 20 ms period)	I_{FAV}	max.	5	A
Repetitive peak forward current	I_{FRM}	max.	14	A
Repetitive peak forward current ($t = 3\ \mu s$)	I_{FRM}	max.	20	A
Temperatures				
Storage temperature	T_{stg}		−55 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	5	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.5	°C/W
From mounting base to heasink with mica washer	$R_{th\ mb\text{-}h}$	=	1.5	°C/W

MECHANICAL DATA Dimensions in mm

Cathode is connected to mounting base



Accessories available: 56203

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[1] Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

CHARACTERISTICS T_j = 25 °C unless otherwise specified

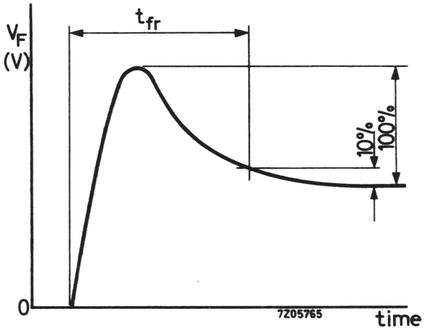
Forward voltage at I_F = 14 A V_F < 1.2 V

Reverse current at V_R = 300 V I_R < 100 μA

Forward recovery time

I_F = 14 A; t_r = 0.25 μs t_{fr} < 1.0 μs

T_j up to 150 °C


t_{fr}
V_F
(V)
10%
100%
0
7Z05765
time

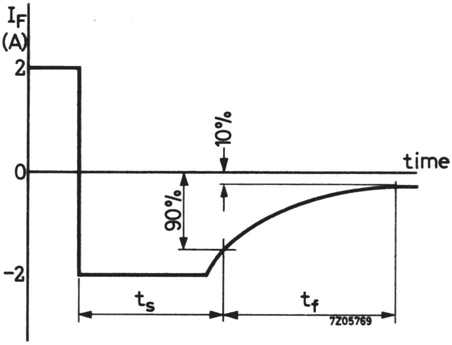
Forward output wave form

Reverse recovery time when switched from

I_F = 2 A to V_R = 30 V; I_R limited to 2 A;
t_r < 0.25 μs ; T_j up to 150 °C

Storage time t_s < 3 μs

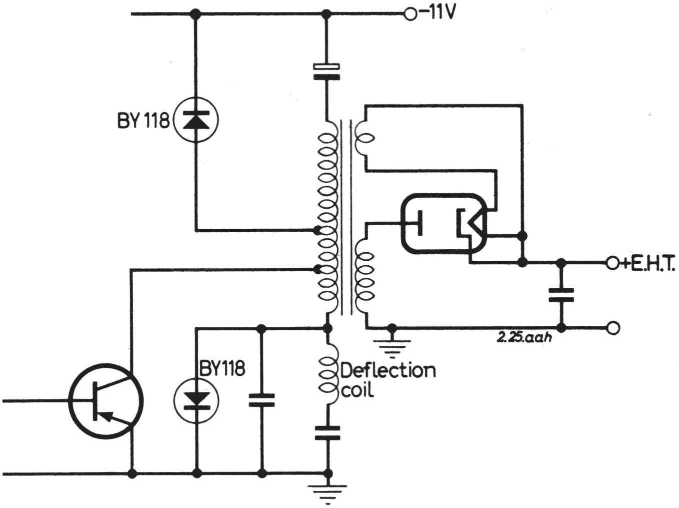
Fall time t_f < 1 μs

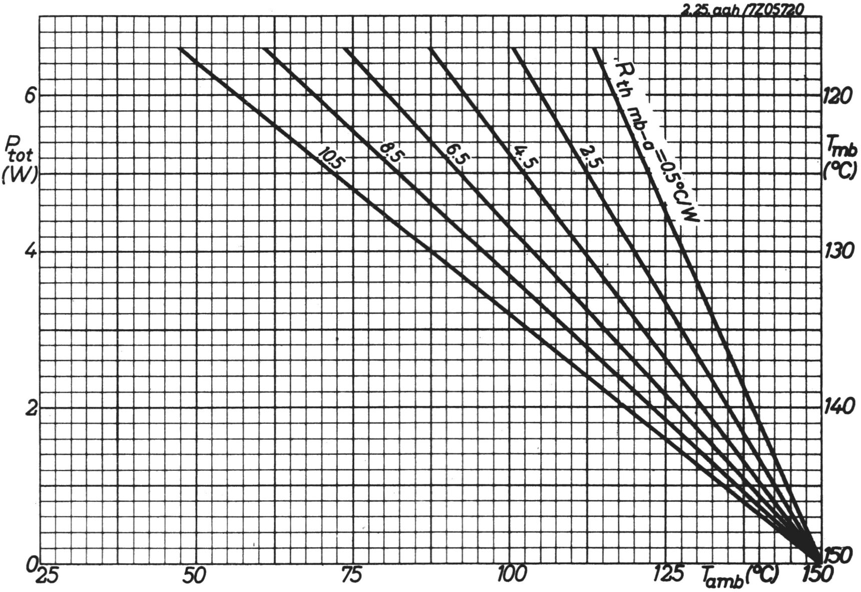

I_F
(A)
2
10%
0
time
90%
-2
t_s
t_f
7Z05769

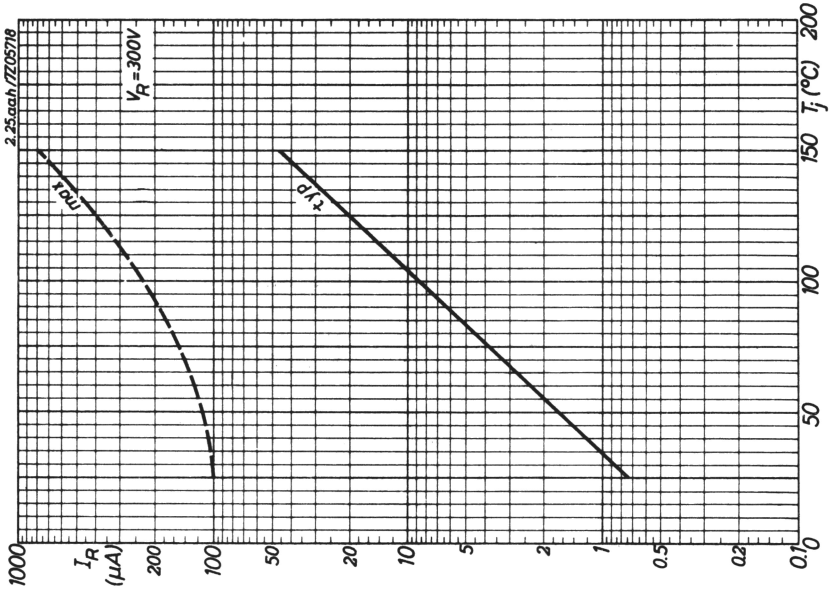
Reverse output wave form

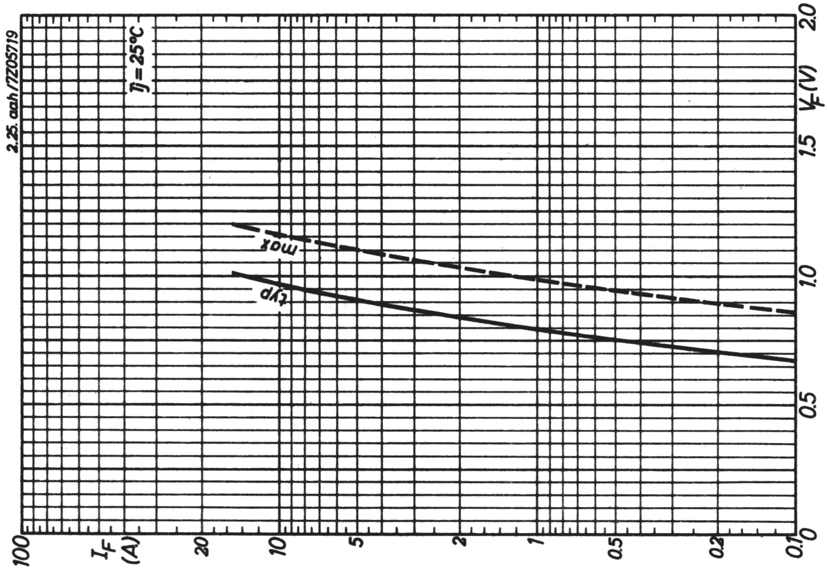
APPLICATION INFORMATION

Typical fundamental line deflection circuit with a series efficiency diode and a parallel efficiency diode.


-11V
BY118
BY118
+E.H.T.
Deflection coil
2.25.aah




2.25.aah/7Z05718
V_R = 300V
max
typ
I_R (μA)
1000
200
100
50
20
10
5
2
1
0.5
0.2
0.1
0
50
100
150
200
T_j (°C)


2.25. aah/7Z05719
Tj = 25°C
max
typ
I_F (A)
100
20
10
5
2
1
0.5
0.2
0.1
0
0.5
1.0
1.5
2.0
V_F (V)

BRIDGE RECTIFIER ASSEMBLIES

BY122: this type has been superseded by the BY164

BY123: this type has been superseded by the BY179

SILICON RECTIFIER DIODES

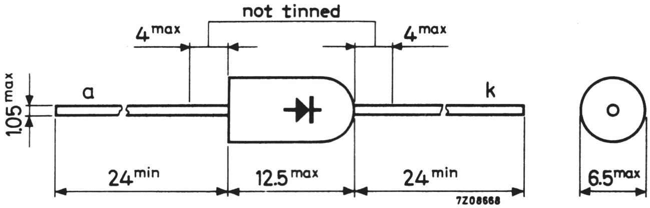
Silicon double diffused rectifier diodes in a plastic envelope. They are intended for mains rectifier applications in television receivers.

QUICK REFERENCE DATA

			BY126	BY127	
Crest working reverse voltage	V_{RWM}	max.	450	800	V
Repetitive peak reverse voltage	V_{RRM}	max.	650	1250	V
Average forward current with R load; $V_{RWM} = V_{RWMmax}$	$I_{F(AV)}$	max.	1.0		A
$V_{RWM} = 60$ V	$I_{F(AV)}$	max.	1.2		A
Non-repetitive peak forward current $t = 10$ ms; $T_j = 150$ °C prior to surge	I_{FSM}	max.	40		A
Junction temperature	T_j	max.	150		°C

MECHANICAL DATA

Dimensions in mm



The rounded end indicates the cathode.

The sealing of the plastic envelope withstands the accelerated damp heat test of IEC recommendation 68-2 (test D, severity IV, 6 cycles).

All information applies to frequencies up to 400 Hz

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

			BY126	BY127	
Crest working reverse voltage	V_{RWM}	max.	450	800	V
Repetitive peak reverse voltage ($\delta \leq 0.01$)	V_{RRM}	max.	650	1250	V
Non-repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	650	1250	V

Currents

Average forward current (averaged over any 20 ms period), see also page 4, 6, 7 with R load; $V_{RWM} = V_{RWMmax}$	$I_{F(AV)}$	max.	1.0	A
$V_{RWM} = 60$ V	$I_{F(AV)}$	max.	1.2	A
Repetitive peak forward current	I_{FRM}	max.	10	A
Non-repetitive peak forward current ($t = 10$ ms; half sine wave) $T_j = 150^{\circ}C$ prior to surge	I_{FSM}	max.	40	A

Temperatures

Storage temperature	T_{stg}		-65 to +150	$^{\circ}C$
Junction temperature	T_j	max.	150	$^{\circ}C$

THERMAL RESISTANCE See page 3

CHARACTERISTICS

Forward voltage

$I_F = 5$ A; $T_j = 25\,^{\circ}C$	V_F	<	1.5	V [1]

Peak reverse current

$V_{RM} = V_{RRMmax}$	I_{RM}	<	10	μA

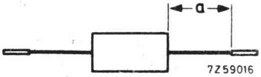
---

[1] measured under pulsed conditions to avoid excessive dissipation

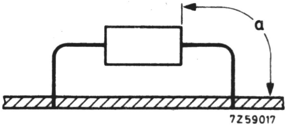
THERMAL RESISTANCE (influence of mounting method)

The quoted values apply when no other leads run to the tie-points. If leads of other dissipating components share the same tie-points, the thermal resistance will be higher than that quoted.

1. Mounted to solder tags at a lead-length a = 10 mm. $R_{th\ j-a}$ = 60 °C/W
2. Mounted to solder tags at a = maximum lead-length. $R_{th\ j-a}$ = 70 °C/W

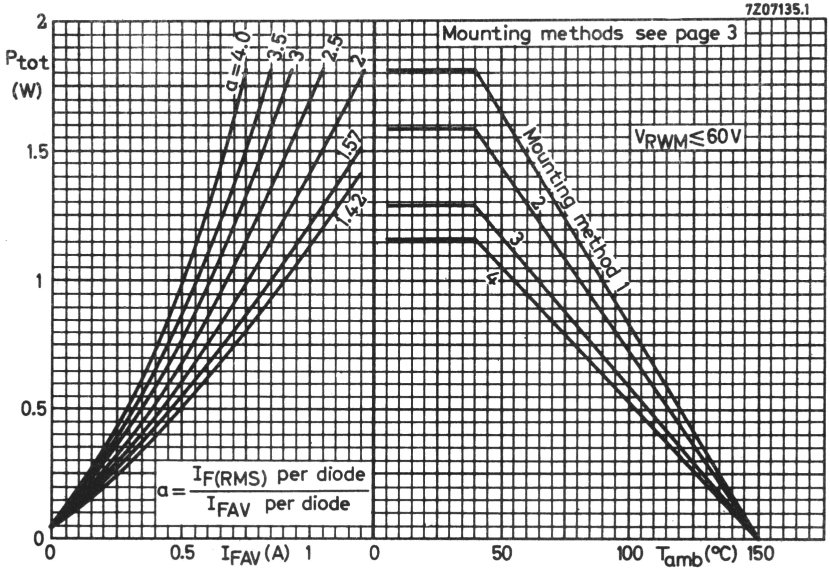


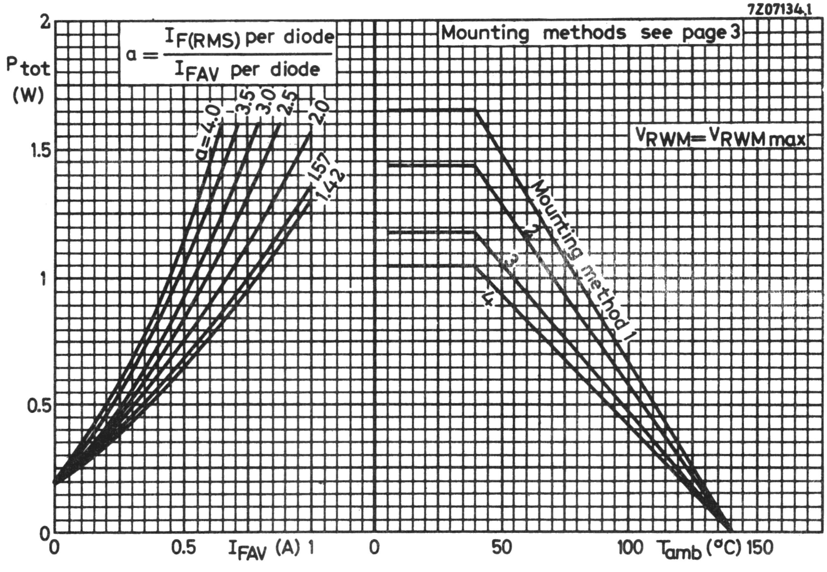
3. Mounted on printed-wiring board at a = maximum lead-length. $R_{th\ j-a}$ = 85 °C/W
4. Mounted on printed-wiring board at a lead-length a = 10 mm. $R_{th\ j-a}$ = 95 °C/W

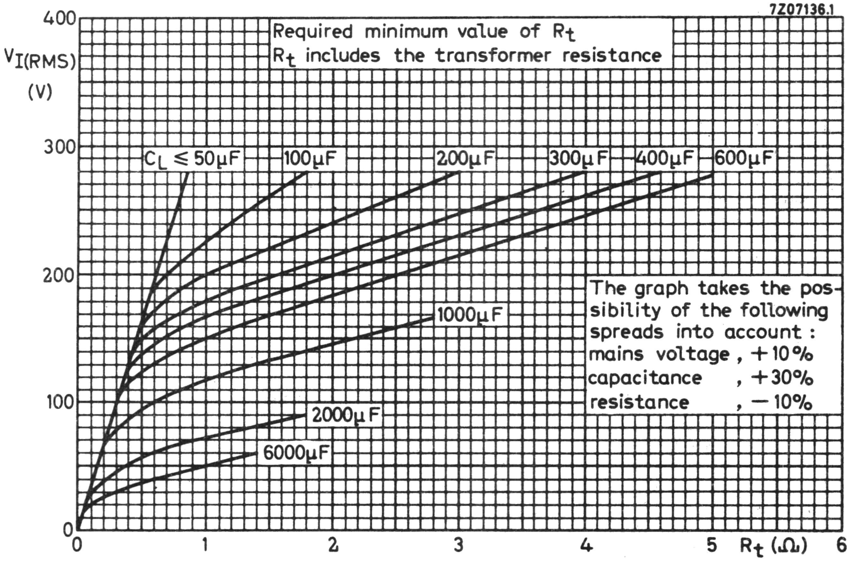


SOLDERING AND MOUNTING NOTES

1. Soldered joints must be at least 5 mm from the seal.
2. The maximum permissible temperature of the soldering iron or bath is 300 °C; it must be in contact with the joint for no more than 3 seconds.
3. Avoid hot spots due to handling or mounting; the body of the device must not come into contact with or be exposed to a temperature higher than 150 °C.


7Z07135.1
Mounting methods see page 3
$V_{RWM} \leq 60\,V$
2
P_{tot}
(W)
1.5
1
0.5
0
a = 4.0
3.5
3
2.5
2
1.57
1.42
$a = \frac{I_{F(RMS)} \text{ per diode}}{I_{FAV} \text{ per diode}}$
Mounting method 1
2
3
4
0
0.5
I_{FAV} (A)
1
0
50
100
T_{amb} (°C)
150


7Z07134.1
$a = \frac{I_{F(RMS)} \text{ per diode}}{I_{FAV} \text{ per diode}}$
Mounting methods see page 3
$V_{RWM} = V_{RWM\,max}$
2
P_{tot}
(W)
1.5
1
0.5
0
a = 4.0
3.5
3.0
2.5
2.0
1.57
1.42
Mounting method 1
2
3
4
0
0.5
I_{FAV} (A)
1
0
50
100
T_{amb} (°C)
150



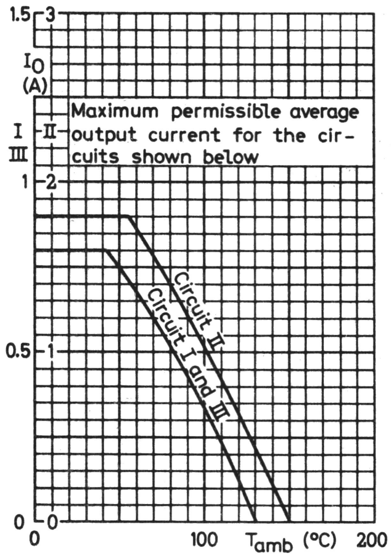
From the left hand graph on page 4 the total power dissipation can be found as a function of the average output current.

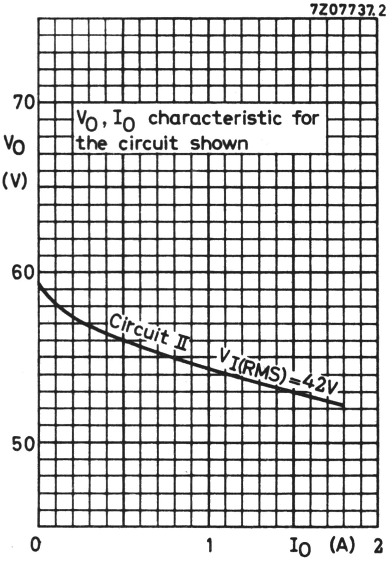
The parameter $a = \frac{I_{F(RMS)}\text{ per diode}}{I_{FAV}\text{ per diode}}$ depends on $n\omega R_L C_L$ and $\frac{R_t + R_{diff}}{nR_L}$ and can be found from existing graphs.

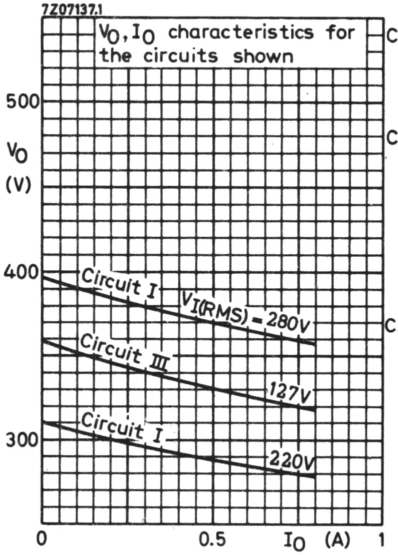
See **Application Book:** RECTIFIER DIODES
Once the power dissipation is known, the max. permissible ambient temperature follows from the right hand graph.

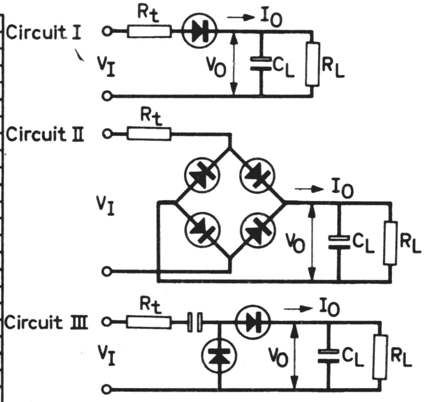
For the series resistance, added to limit the initial peak rectifier current, the required minimum value can be found from the upper graph.
R_{diff} is shown on page 7.

EXAMPLE: Rectifier with C-load
mounting method 1 (see page 3)

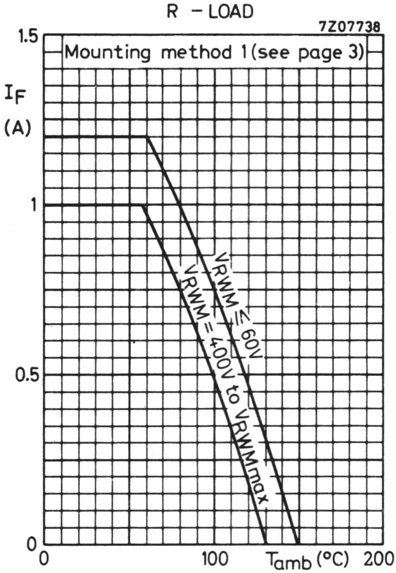


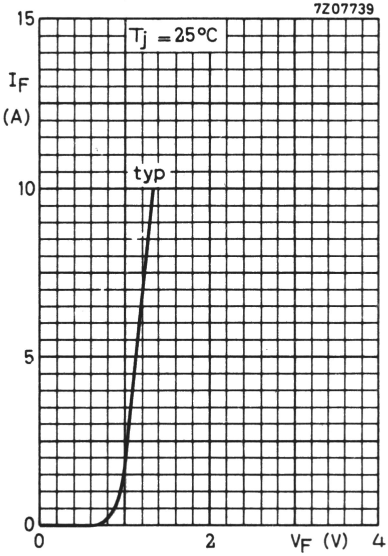


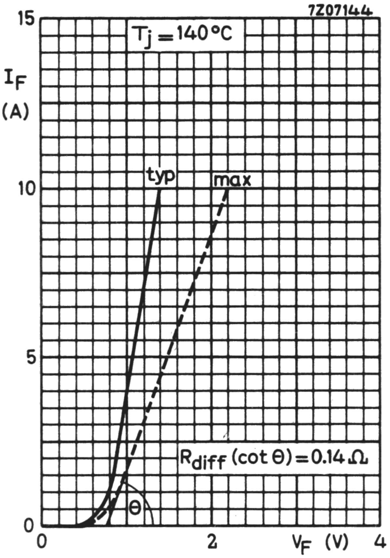


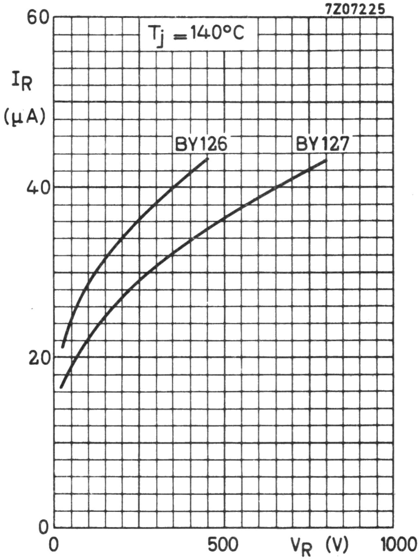

Circuit I
R_t
I_O
V_I
V_O
C_L
R_L
Circuit II
R_t
V_I
I_O
V_O
C_L
R_L
Circuit III
R_t
I_O
V_I
V_O
C_L
R_L

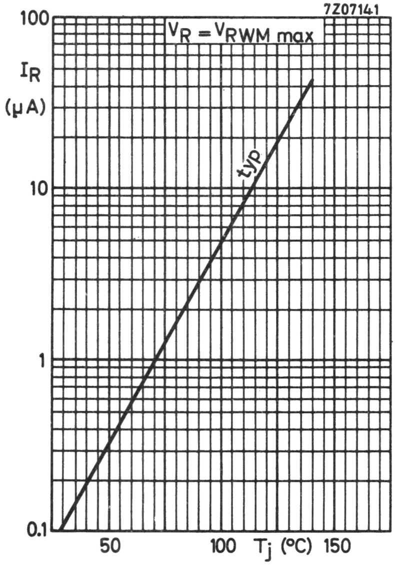
	$V_{I(RMS)}$	R_t	C_L
Circuit I	220V 280V	1.4 Ω 3.0 Ω	200 μF 200 μF
Circuit II	42V	0.72 Ω	6000 μF
Circuit III	127V	0.4 Ω	400 μF

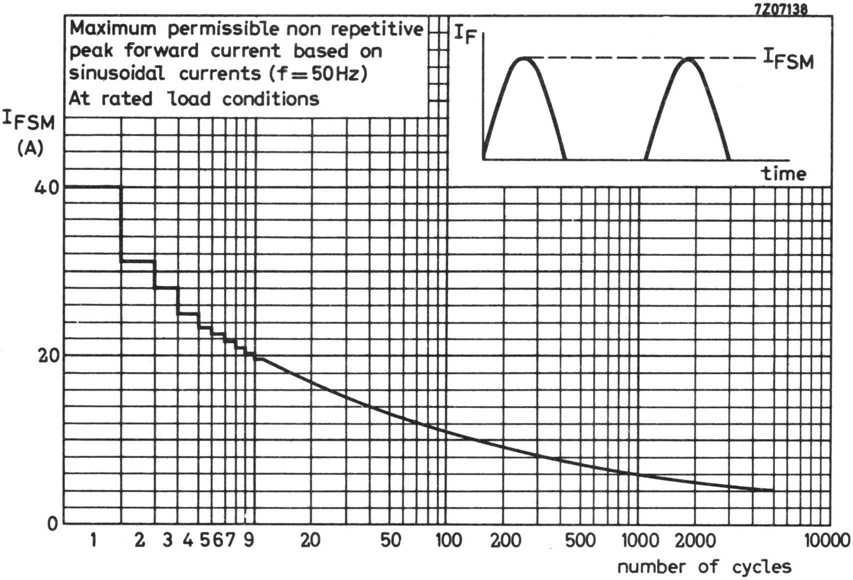

R – LOAD
7Z07738
Mounting method 1 (see page 3)
I_F
(A)
1.5
1
0.5
0
$V_{RWM} \leq 60V$
$V_{RWM} = 400V$ to V_{RWMmax}
0
100
T_{amb} (°C)
200


7Z07739
$T_j = 25°C$
I_F
(A)
15
10
5
0
typ
0
2
V_F (V)
4


7Z07144
$T_j = 140°C$
I_F
(A)
15
10
5
0
typ
max
R_{diff} (cot Θ) = 0.14 Ω
Θ
0
2
V_F (V)
4


7Z07225
T_j = 140°C
I_R (μA)
60
40
20
0
BY126
BY127
0
500
V_R (V)
1000


7Z07141
$V_R = V_{RWM\ max}$
I_R (μA)
100
10
1
0.1
typ
50
100
T_j (°C)
150


7Z07138
Maximum permissible non repetitive peak forward current based on sinusoidal currents (f = 50 Hz)
At rated load conditions
I_F
I_{FSM}
time
I_{FSM} (A)
40
20
0
1
2
3
4
5
6
7
9
20
50
100
200
500
1000
2000
10000
number of cycles

HIGH SPEED HIGH VOLTAGE DIODE

This type has been superseded by the BY176

BRIDGE RECTIFIER ASSEMBLY

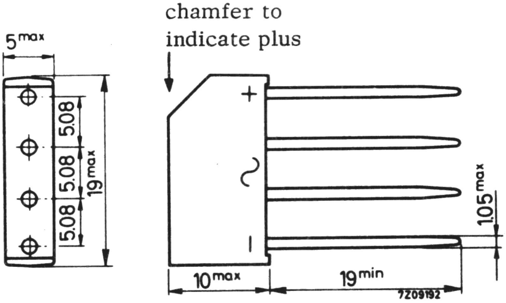
Plastic encapsulated bridge rectifier assembly comprising four silicon double diffused diodes.
It is primarily intended for use in the power supplies of many types of transistorized equipment operating at frequencies up to 400 Hz.

QUICK REFERENCE DATA

Input				
R.M.S. voltage	$V_{I(RMS)}$	max.	60	V
Repetitive peak voltage	V_{IRM}	max.	120	V
Output				
Continuous voltage				
with C load	V_O		85	V
with R load	V_O		54	V
Average current with				
with R load $V_{I(RMS)} \leq 60$ V	I_O	max.	1.2	A
$V_{I(RMS)} \leq 42$ V	I_O	max.	1.4	A
Repetitive peak current	I_{ORM}	max.	5	A

MECHANICAL DATA

Dimensions in mm



The sealing of the plastic envelope withstands the accelerated damp heat test of IEC recommendation 68-2 (test D, severity IV, 6 cycles)

All information applies to mains frequencies up to 400 Hz.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Input

R.M.S. voltage	$V_{I(RMS)}$	max.	60	V
Crest working voltage	V_{IWM}	max.	85	V
Repetitive peak voltage	V_{IRM}	max.	120	V
Non repetitive peak voltage; $t \leq 10$ ms	V_{ISM}	max.	120	V
Non repetitive peak current (see also page 6)	I_{ISM}	max.	25	A

Output

Average current with C load	See pages 3, 4 and 5			
Average current with R and L load (see also page 6)				
$V_{I(RMS)} \leq 60$ V	I_O	max.	1.2	A
$V_{I(RMS)} \leq 42$ V	I_O	max.	1.4	A
Repetitive peak current	I_{ORM}	max.	5	A

Temperatures

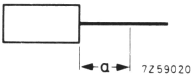
Storage temperature	T_{stg}	-55 to +125		°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

Effect of mounting on thermal resistance $R_{th\ j\text{-}a}$

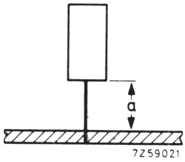
The quoted values apply when no other leads run to the tie-points. If leads of other dissipating components share the same tie-points, the thermal resistance will be higher than that quoted.

1. Mounted to solder tags at a lead-length a > 5 mm. $R_{th\ j\text{-}a} = 40\ ^{\circ}C/W$



2. Mounted on printed-wiring board at a = maximum lead-length. $R_{th\ j\text{-}a} = 50\ ^{\circ}C/W$
3. Mounted on printed-wiring board at a lead-length a = 5 mm. $R_{th\ j\text{-}a} = 55\ ^{\circ}C/W$

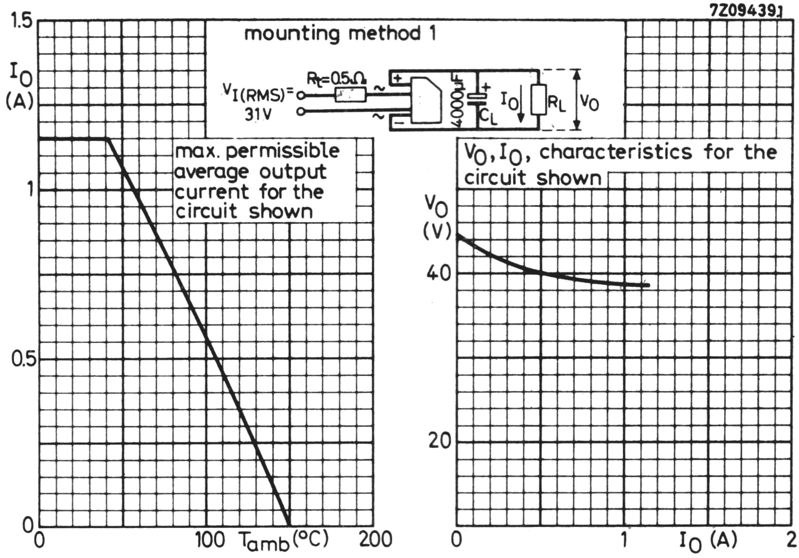
→ 4. Mounted on printed-wiring board at a lead-length a = 1.5 mm. $R_{th\ j\text{-}a} = 60\ ^{\circ}C/W$
(distance -a- is including printed-wiring board thickness)

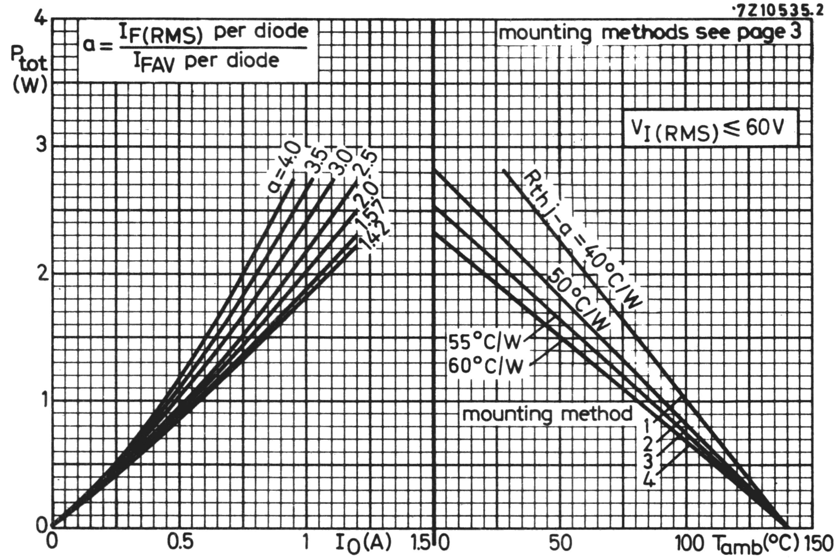


SOLDERING AND MOUNTING NOTES

1. The maximum permissible contact time for the soldering iron or bath is 3 seconds.
2. If the soldered joints are at least 5 mm from the seal, the maximum permissible temperature of the soldering iron or bath is 270 °C. If the joints are between 1.5 mm (min) and 5 mm from the seal, the maximum permissible temperature is 250 °C.
3. Avoid hot spots due to handling or mounting; the body of the device must not come into contact with or be exposed to a temperature higher than 150 °C.

EXAMPLE: Rectifier with C load



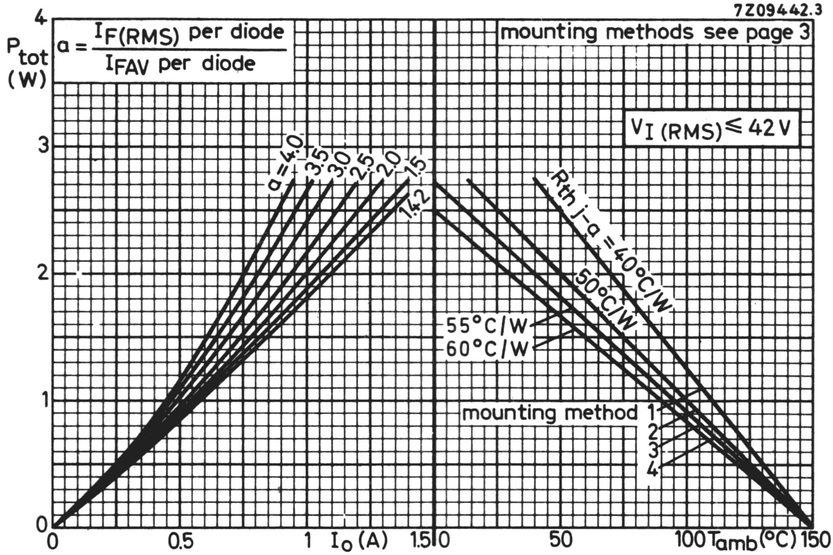


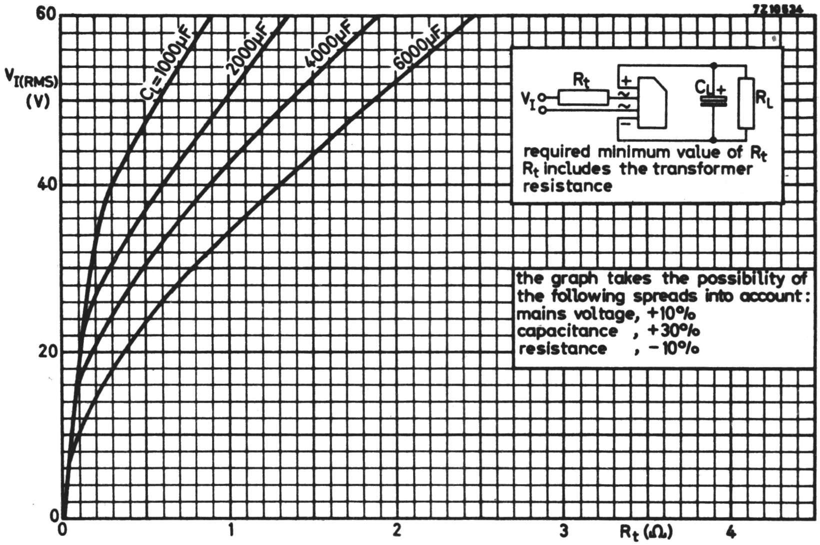
From the lefthand graph the total power dissipation can be found as a function of the average output current.

The parameter $a = \frac{I_{F(RMS)} \text{ per diode}}{I_{FAV} \text{ per diode}}$ depends on $\omega R_L C_L$ and $\frac{R_t + R_{diff}}{R_L}$ and can be found from existing graphs.

See Application Book: RECTIFIER DIODES.
Once the power dissipation is known, the max. permissible ambient temperature follows from the right hand graph.

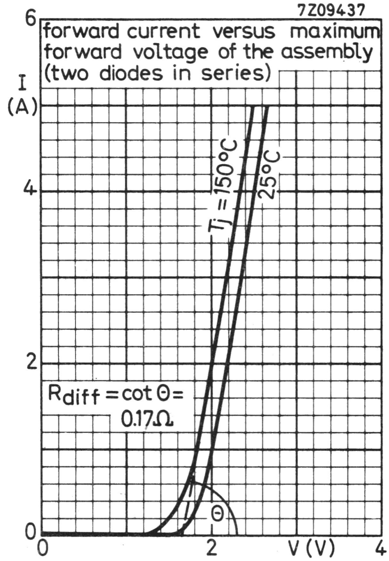
For the series resistance, added to limit the initial peak rectifier current, the required minimum value can be found from the lower graph on page 5.
R_{diff} is shown on page 6, left hand upper figure.

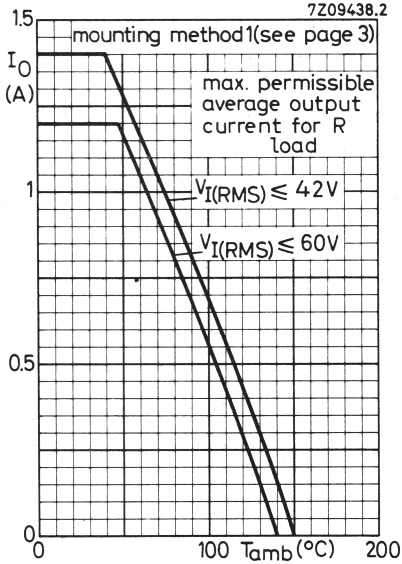


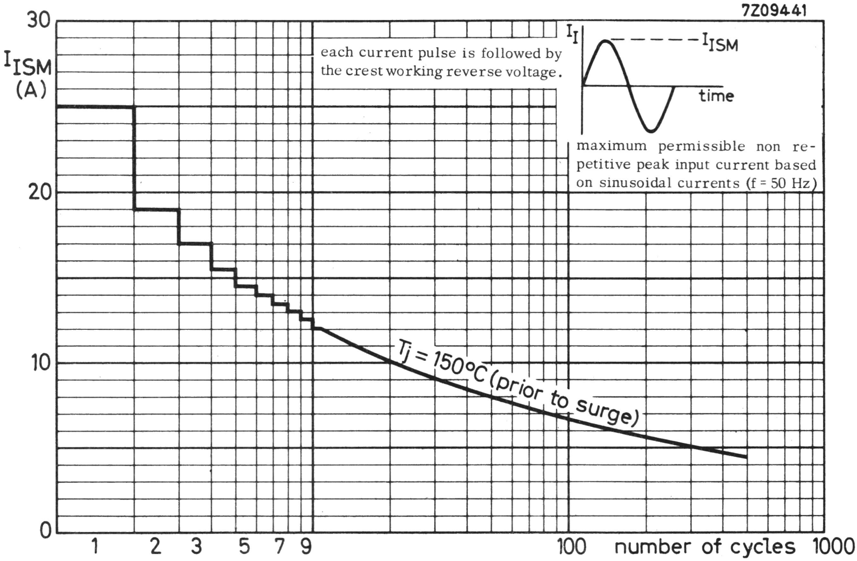


required minimum value of R_t
R_t includes the transformer resistance

the graph takes the possibility of the following spreads into account:
mains voltage, +10%
capacitance , +30%
resistance , −10%


7Z09437
forward current versus maximum forward voltage of the assembly (two diodes in series)
I (A)
6
4
2
0
Tj = 150°C
25°C
Rdiff = cot Θ = 0.17Ω
Θ
0
2
V (V)
4


7Z09438.2
mounting method 1 (see page 3)
IO (A)
1.5
1
0.5
0
max. permissible average output current for R load
VI(RMS) ≤ 42V
VI(RMS) ≤ 60V
0
100
Tamb (°C)
200


7Z09441
IISM (A)
30
20
10
0
each current pulse is followed by the crest working reverse voltage.
II
IISM
time
maximum permissible non repetitive peak input current based on sinusoidal currents (f = 50 Hz)
Tj = 150°C (prior to surge)
1
2
3
5
7
9
100
number of cycles
1000

SILICON E.H.T. RECTIFIER DIODE

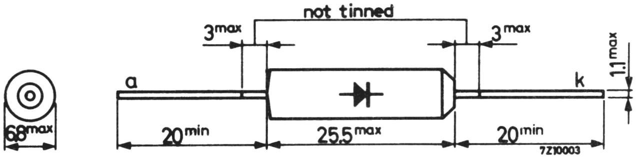
Silicon e.h.t. rectifier diode in a plastic envelope intended for tripler circuits, tiny-vision receivers and as focus rectifiers in colour television receivers.

QUICK REFERENCE DATA

Crest working reverse voltage	V_{RWM}	max.	15	kV
Repetitive peak reverse voltage	V_{RRM}	max.	15	kV
Average forward current	I_{FAV}	max.	2.5	mA
Junction temperature	T_j	max.	95	$^{\circ}C$
Recovered charge when switched from I_F = 200 mA to V_R = 100 V with $-\frac{dI}{dt}$ = 200 mA/μs	Q_s	typ.	5	nC

MECHANICAL DATA

Dimensions in mm


not tinned
3max
3max
1.1max
a
k
6.8max
20min
25.5max
20min
7Z10003

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages 1)

Crest working reverse voltage	V_{RWM}	max.	15	kV
Repetitive peak reverse voltage	V_{RRM}	max.	15	kV
Non repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	15	kV

Currents

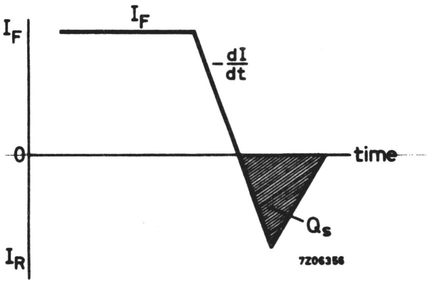
Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	2.5	mA
Repetitive peak forward current	I_{FRM}	max.	250	mA 2)
Repetitive peak reverse current during switching off	I_{RRM}	max.	150	mA

Temperatures

Storage temperature	T_{stg}		−55 to +100	°C
Junction temperature	T_j	max.	95	°C

CHARACTERISTICS

Forward voltage at I_F = 100 mA; T_j = 95 °C	V_F	<	35	V
Reverse current at V_R = 15 kV; T_j = 75 °C	I_R	<	7.0	μA
Recovered charge when switched from I_F = 200 mA to V_R = 100 V with $-\frac{dI}{dt}$ = 200 mA/μs; T_j = 25 °C	Q_s	typ.	5	nC



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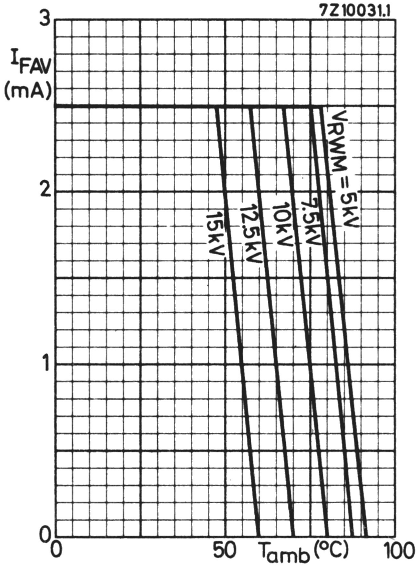
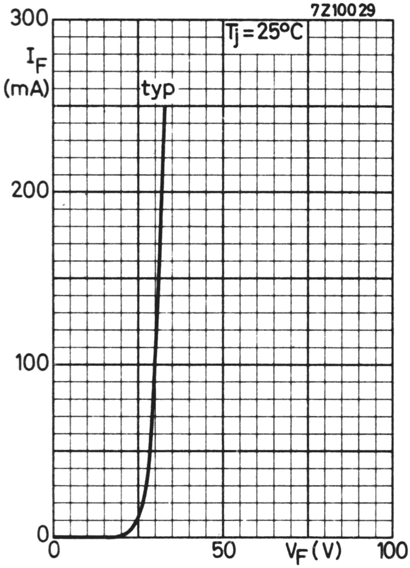
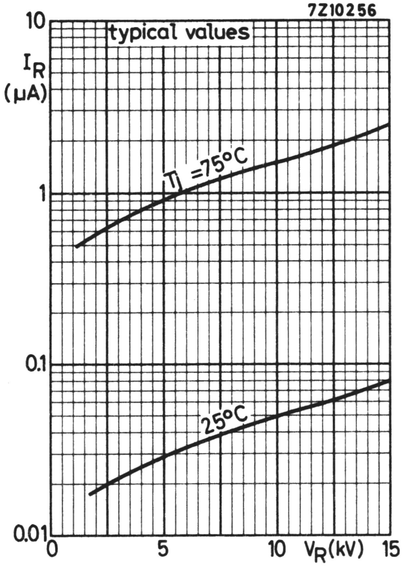
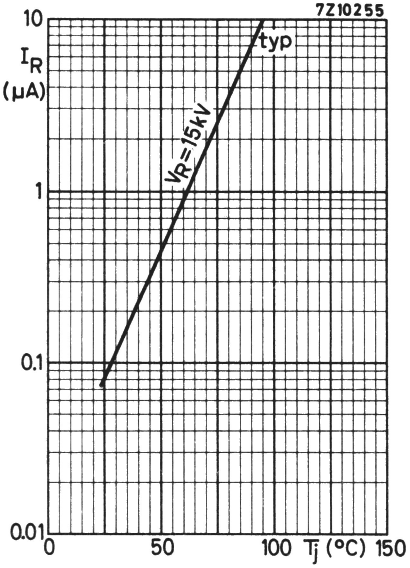
1) During initial line-up a reverse voltage of 17 kV is allowed at T_{amb} = 40 °C

2) The rectifier can withstand flash-over currents in the picture tube.


7Z10031.1
3
2
1
0
I_{FAV}
(mA)
V_{RWM} = 5kV
7.5kV
10kV
12.5kV
15kV
0
50
T_{amb} (°C)
100


7Z10029
300
200
100
0
I_F
(mA)
T_j = 25°C
typ
0
50
V_F (V)
100

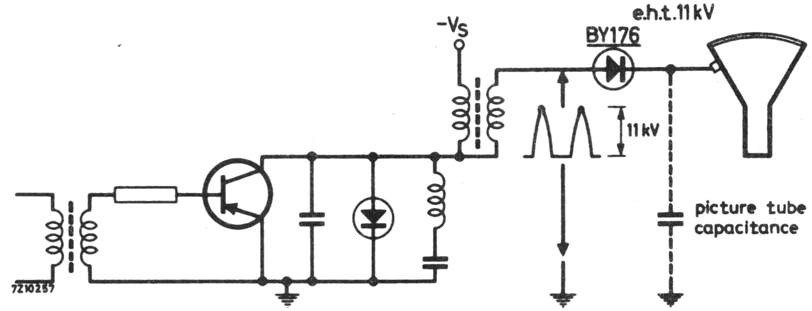

7Z10256
10
1
0.1
0.01
I_R
(μA)
typical values
T_j = 75°C
25°C
0
5
10
V_R(kV)
15


7Z10255
10
1
0.1
0.01
I_R
(μA)
typ
V_R = 15kV
0
50
100
T_j (°C)
150

APPLICATION INFORMATION

E.H.T. rectifier circuits

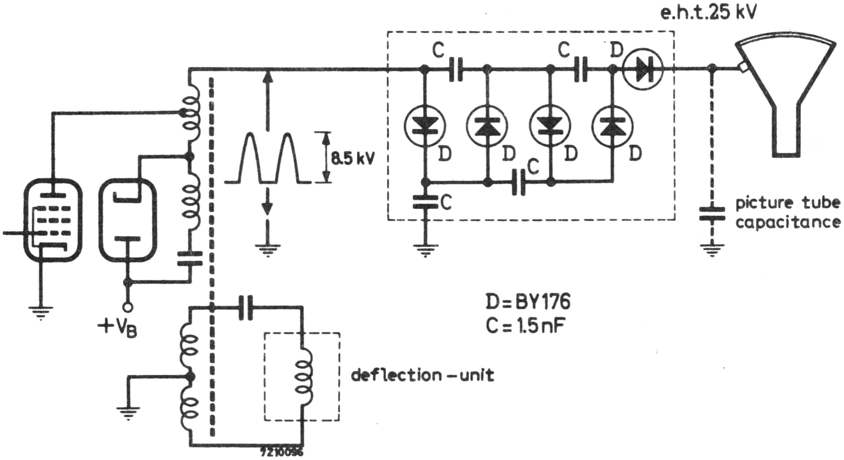
A.


-V_S
e.h.t.11 kV
BY176
11 kV
picture tube capacitance
7Z10257

Typical deflection circuit for small screen television receivers employing the BY176 an an e.h.t. rectifier. Proper operation of the BY176 is ensured up to an ambient temperature of 60 °C.

The contribution of the BY176 to the overall e.h.t. regulation of the circuit is negligibly small.

B.


e.h.t.25 kV
C
C
D
D
D
D
D
C
C
8.5 kV
picture tube capacitance
+V_B
D = BY176
C = 1.5 nF
deflection-unit
7Z10096

E.H.T. supply for colour television receivers by means of a tripler circuit employing BY176 diodes. Proper operation of the BY176 diodes is ensured up to an ambient temperature of 70 °C.

Contribution to the regulation of the complete horizontal deflection output circuit due to the tripler system (inside the dashed-lines): 600 kΩ.

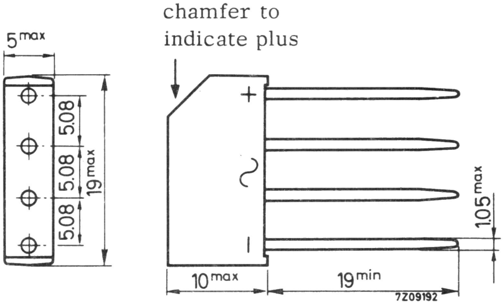
BRIDGE RECTIFIER ASSEMBLY

Plastic encapsulated bridge rectifier assembly comprising four silicon double diffused diodes.
It is primarily intended for equipment drawing its power from mains with frequencies up to 400 Hz.

QUICK REFERENCE DATA				
Input				
R.M.S. voltage	$V_{I(RMS)}$	max.	280	V
Repetitive peak voltage	V_{IRM}	max.	800	V
Output				
Continuous voltage				
with C load	V_O		400	V
with R load	V_O		255	V
Average current with R load up to T_{amb} = 40 °C	I_O	max.	1	A
Repetitive peak current	I_{ORM}	max.	5	A

MECHANICAL DATA

Dimensions in mm


chamfer to indicate plus
5 max
5.08
5.08
5.08
19 max
+
~
−
1.05 max
10 max
19 min
7Z09192

The sealing of the plastic envelope withstands the accelerated damp heat test of IEC recommendation 68-2 (test D, severity IV, 6 cycles)

All information applies to mains frequencies up to 400 Hz.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

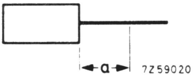
Input				
R.M.S. voltage	$V_{I(RMS)}$	max.	280	V
Crest working voltage	V_{IWM}	max.	400	V
Repetitive peak voltage	V_{IRM}	max.	800	V
Non repetitive peak voltage; $t \leq 10$ ms	V_{ISM}	max.	800	V
Non repetitive peak current (see also page 6)	I_{ISM}	max.	25	A
Output				
Average current with C load	See pages 4 and 5			
Average current with R and L load up to T_{amb} = 40 °C (see also page 5)	I_O	max.	1	A
Repetitive peak current	I_{ORM}	max.	5	A
Temperatures				
Storage temperature	T_{stg}	-55 to +125		°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

Effect of mounting on thermal resistance $R_{th\ j-a}$

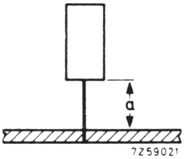
The quoted values apply when no other leads run to the tie-points. If leads of other dissipating components share the same tie-points, the thermal resistance will be higher than that quoted.

1. Mounted to solder tags at a lead-length a > 5 mm. $R_{th\ j-a}$ = 40 °C/W



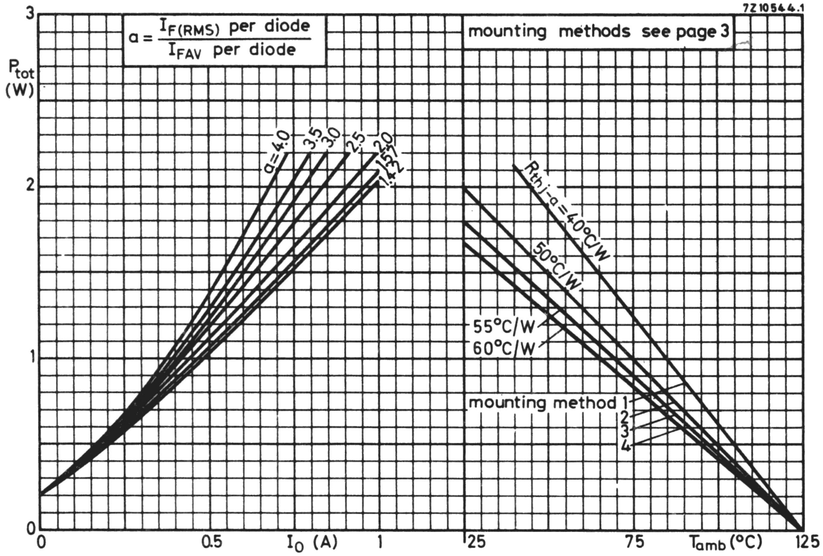
2. Mounted on printed-wiring board at a = maximum lead-length. $R_{th\ j-a}$ = 50 °C/W
3. Mounted on printed-wiring board at a lead-length a = 5 mm. $R_{th\ j-a}$ = 55 °C/W

→ 4. Mounted on printed-wiring board at a lead length a = 1.5 mm. $R_{th\ j-a}$ = 60 °C/W (distance -a- including printed-wiring board thickness)



SOLDERING AND MOUNTING NOTES

1. The maximum permissible contact time for the soldering iron or bath is 3 seconds.
2. If the soldered joints are at least 5 mm from the seal, the maximum permissible temperature of the soldering iron or bath is 270 °C. If the joints are between 1.5 mm (min) and 5 mm from the seal, the maximum permissible temperature is 250 °C.
3. Avoid hot spots due to handling or mounting; the body of the device must not come into contact with or be exposed to a temperature higher than 150 °C.

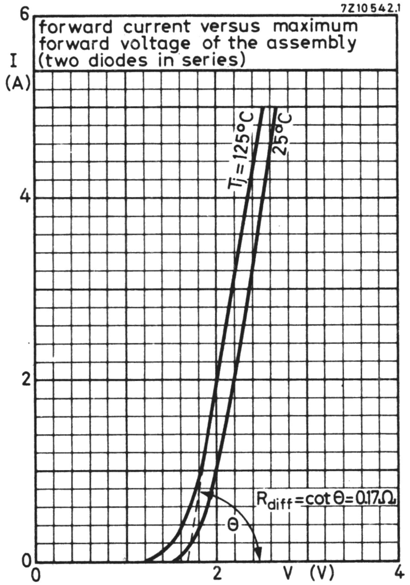


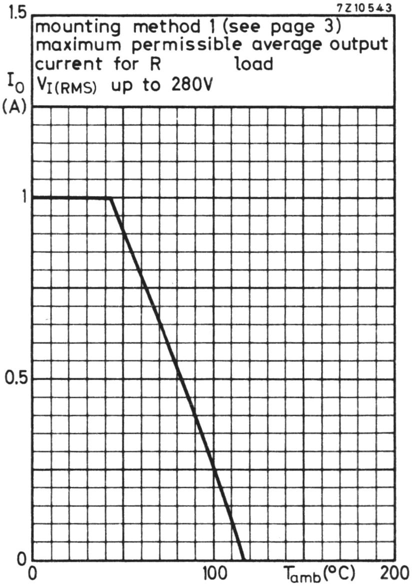
From the lefthand graph the total power dissipation can be found as a function of the average output current.

The parameter $a = \frac{I_{F(RMS)} \text{ per diode}}{I_{FAV} \text{ per diode}}$ depends on $\omega R_L C_L$ and $\frac{R_t + R_{diff}}{R_L}$ and can be found from existing graphs.

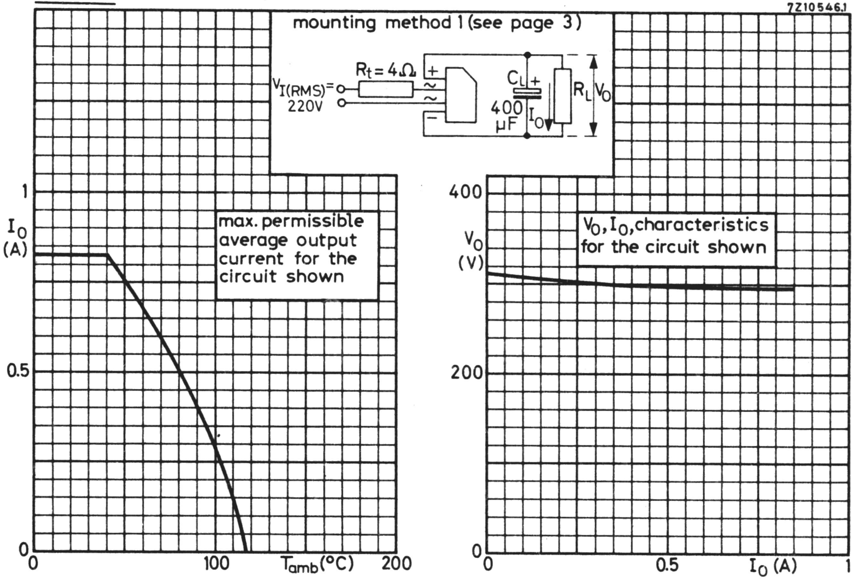
See Application Book: RECTIFIER DIODES.
Once the power dissipation is known, the max. permissible ambient temperature follows from the right hand graph.

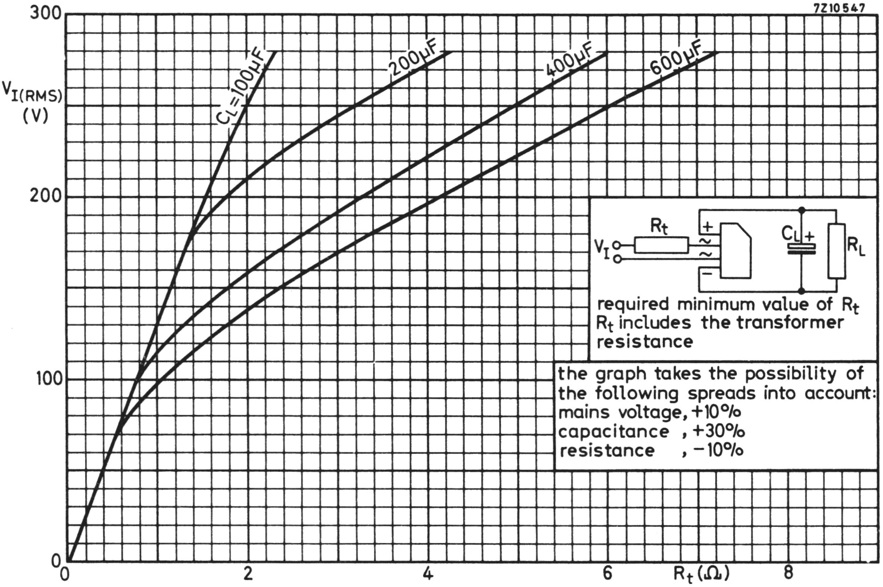
For the series resistance, added to limit the initial peak rectifier current, the required minimum value can be found from the upper graph on page 6.
R_{diff} is shown on page 5, left hand upper graph.





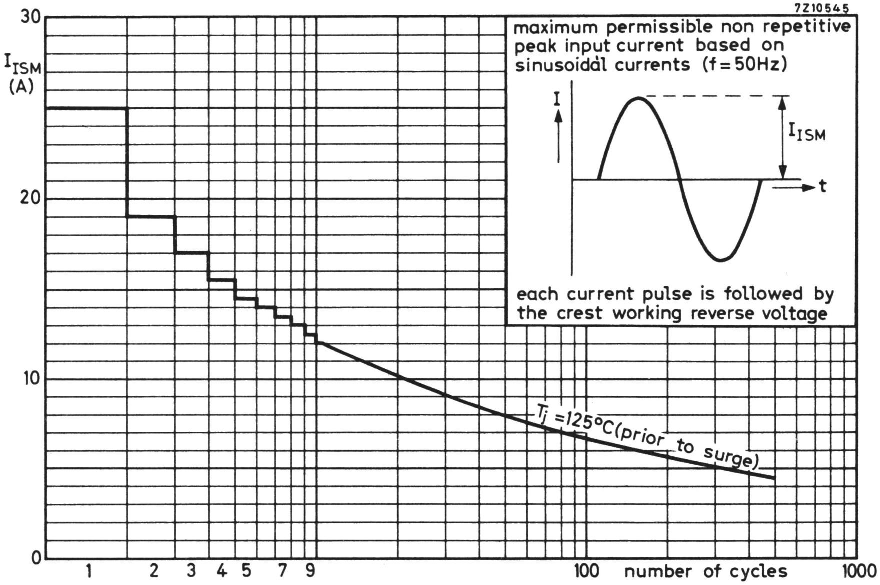
EXAMPLE: rectifier with C load





required minimum value of R_t
R_t includes the transformer resistance

the graph takes the possibility of the following spreads into account:
mains voltage, +10%
capacitance , +30%
resistance , −10%



maximum permissible non repetitive peak input current based on sinusoidal currents (f = 50Hz)

each current pulse is followed by the crest working reverse voltage

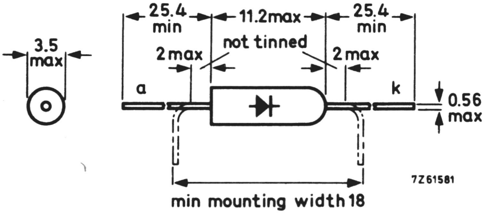
SILICON HIGH VOLTAGE DIODE

Diode in a plastic envelope intended for use as V_{g2} supply in colour television receivers.

QUICK REFERENCE DATA				
Crest working reverse voltage	V_{RWM}	max.	1500	V
Repetitive peak reverse voltage	V_{RRM}	max.	1800	V
Average forward current	I_{FAV}	max.	2.0	mA
Repetitive peak forward current	I_{FRM}	max.	100	mA
Junction temperature	T_j	max.	75	^oC
Recovered charge when switched from I_F = 10 mA to V_R = 2 V with $-\frac{dI}{dt}$ = 5 mA/µs	Q_s	typ.	1	nC

MECHANICAL DATA

Dimensions in mm


3.5
max
25.4
min
11.2max
25.4
min
not tinned
2 max
2 max
a
k
0.56
max
7Z61581
min mounting width 18

The envelope fulfils the accelerated damp heat test described in I.E.C. publication 68-2 (test D, severity IV, 6 cycles).

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

Crest working reverse voltage	V_{RWM}	max.	1500	V
Repetitive peak reverse voltage	V_{RRM}	max.	1800	V
Non repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	1800	V

Currents

Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	2.0	mA
Repetitive peak forward current	I_{FRM}	max.	100	mA
Non repetitive peak forward current ($t \leq 10$ ms)	I_{FSM}	max.	1000	mA

Temperatures

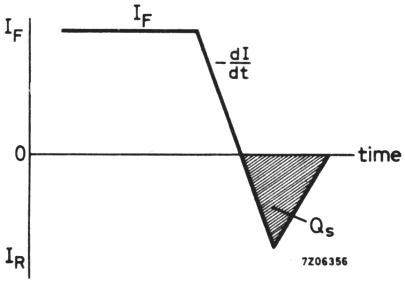
Storage temperature	T_{stg}		−65 to +100	°C
Junction temperature	T_j	max.	75	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	175	°C/W

CHARACTERISTICS

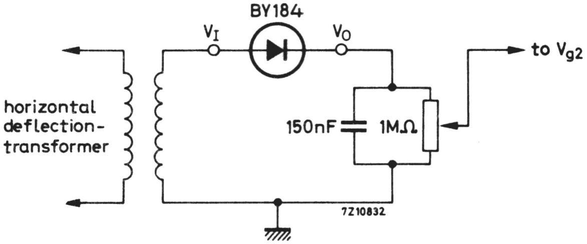
Forward voltage at $I_F = 100$ mA; $T_j = 75$ °C	V_F	<	5	V
Reverse current at $V_R = 1500$ V; $T_j = 75$ °C	I_R	<	10	μA
Recovered charge when switched from $I_F = 10$ mA to $V_R = 2$ V with $-\frac{dI}{dt} = 5$ mA/μs; $T_j = 25$ °C	Q_s	typ.	1	nC

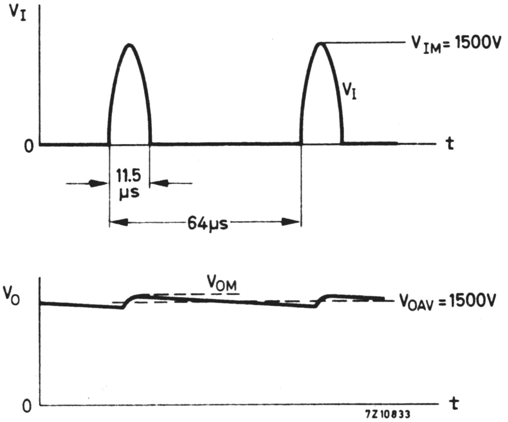


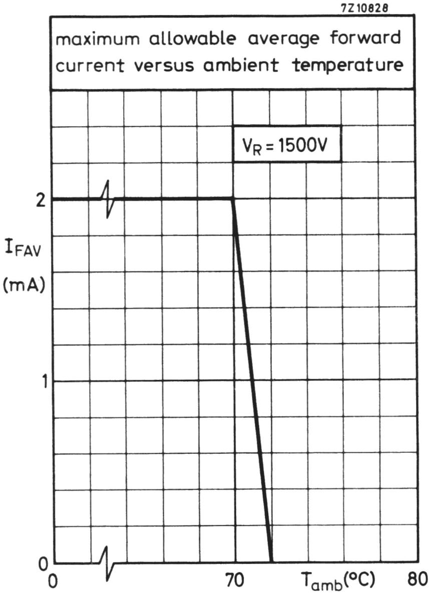
APPLICATION INFORMATION

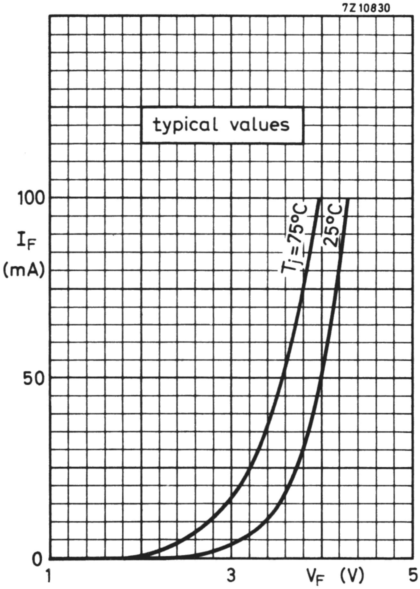
Basic circuit for V_{g2} supply in colour television receivers.

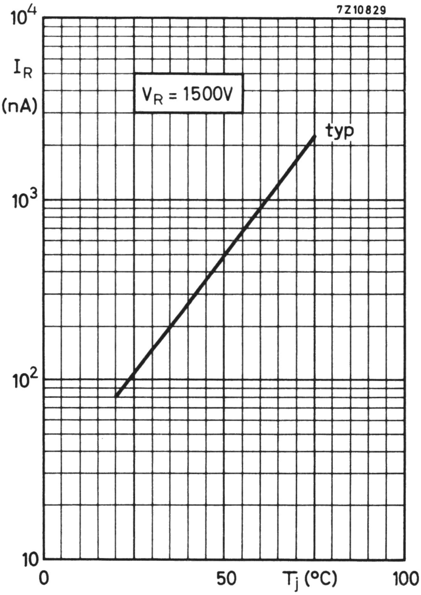
Stable continuous operation is ensured at an ambient temperature up to 70 °C


BY184
V_I
V_O
to V_{g2}
horizontal deflection-transformer
150nF
1MΩ
7Z10832




7Z10828
maximum allowable average forward current versus ambient temperature
V_R = 1500V
2
I_{FAV}
(mA)
1
0
0
70
T_{amb}(°C)
80


7Z10830
typical values
100
I_F
(mA)
50
0
T_j = 75°C
25°C
1
3
V_F (V)
5


7Z10829
10^4
I_R
(nA)
V_R = 1500V
typ
10^3
10^2
10
0
50
T_j (°C)
100

SILICON E.H.T. RECTIFIER DIODE

E.H.T. rectifier diode in a plastic envelope intended for use in horizontal deflection circuits of colour television receivers.

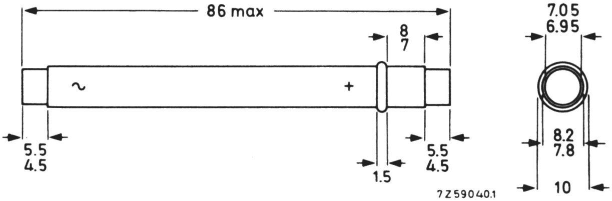
For application of the diode the usual high voltage precautions should be taken into account to avoid corona phenomena etc. Because of the voltage gradient across the stack a metal cap must be used.

QUICK REFERENCE DATA

Crest working reverse voltage	V_{RWM}	max.	35	kV
Repetitive peak reverse voltage	V_{RRM}	max.	35	kV
Average forward current	$I_{F(AV)}$	max.	2.5	mA
Junction temperature	T_j	max.	85	°C
Recovered charge when switched from I_F = 200 mA to V_R = 100 V with $-\frac{dI}{dt}$ = 200 mA/µs	Q_s	typ.	5	nC

MECHANICAL DATA

Dimensions in mm



RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages 1)

Crest working reverse voltage	V_{RWM}	max.	35	kV
Repetitive peak reverse voltage	V_{RRM}	max.	35	kV
Non-repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	35	kV

Currents

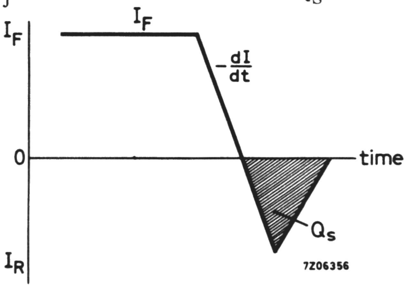
Average forward current (averaged over any 20 ms period)	$I_{F(AV)}$	max.	2.5	mA
Repetitive peak forward current	I_{FRM}	max.	200	mA 2)
Repetitive peak forward current during 20 % of vertical deflection period time	I_{FRM}	max.	500	mA 2)
Repetitive peak reverse current during switching off	I_{RRM}	max.	150	mA

Temperatures

Storage temperature	T_{stg}	-55 to	+85	°C
Junction temperature	T_j	max.	85	°C

CHARACTERISTICS

Forward voltage at $I_F = 200$ mA; $T_j = 75$ °C	V_F	<	120	V
Reverse current at $V_R = 35$ kV; $T_j = 75$ °C	I_R	<	10	µA
Recovered charge when switched from I_F = 200 mA to V_R = 100 V with $-\frac{dI}{dt}$ = 200 mA/µs; T_j = 25 °C	Q_s	typ.	5	nC



---

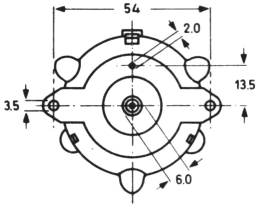
1) During initial line-up a reverse voltage of 43 kV is allowed at T_{amb} = 50 °C

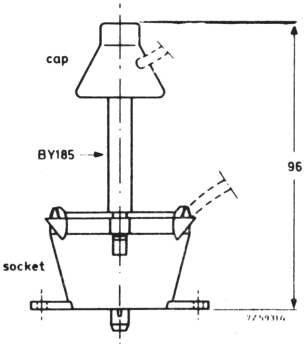
2) The rectifier can withstand flash-over currents in the picture tube.

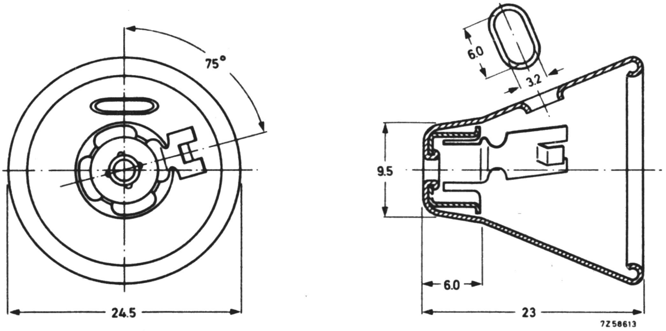
ACCESSORIES supplied on request:

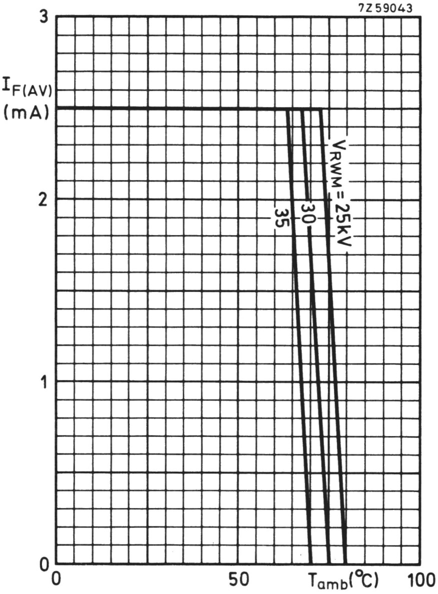
Dimensions in mm

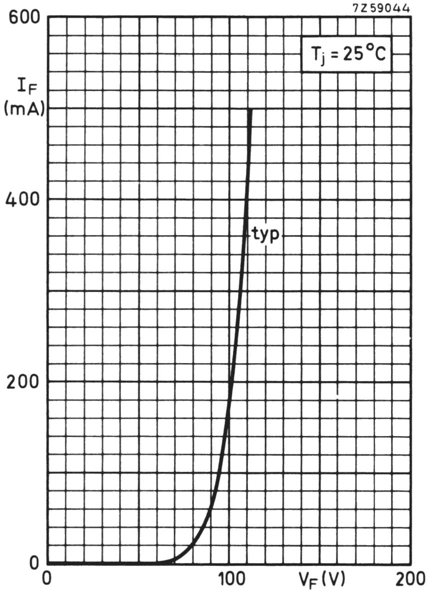
AT7107 = socket + cap
AT7107/10 = socket

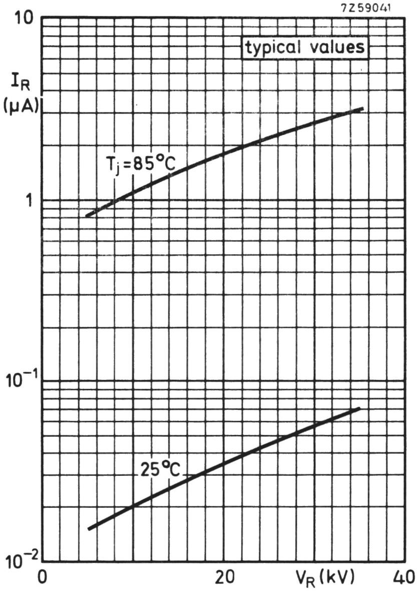

54
2.0
13.5
3.5
6.0

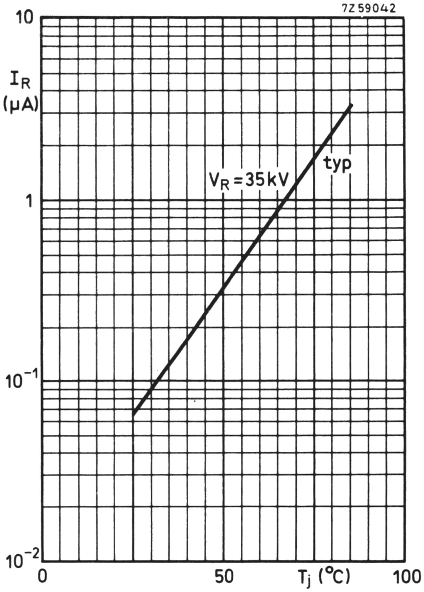

cap
BY185
96
socket
7Z59314

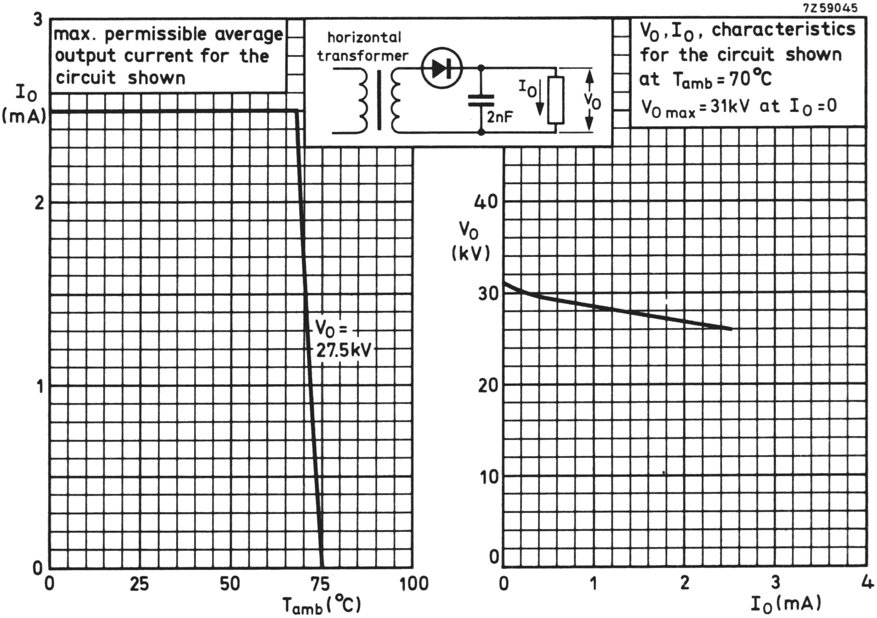

75°
24.5
6.0
3.2
9.5
6.0
23
7Z58613


7Z59043
I_F(AV) (mA)
3
2
1
0
0
50
T_amb (°C)
100
V_RWM = 25 kV
30
35


7Z59044
I_F (mA)
600
400
200
0
0
100
V_F (V)
200
T_j = 25 °C
typ


7Z59041
typical values
I_R (µA)
10
1
10^-1
10^-2
0
20
V_R (kV)
40
T_j = 85 °C
25 °C


7Z59042
I_R (µA)
10
1
10^-1
10^-2
0
50
T_j (°C)
100
V_R = 35 kV
typ


7Z59045
max. permissible average output current for the circuit shown
horizontal transformer
2nF
I_O
V_O
V_O, I_O, characteristics for the circuit shown at T_{amb} = 70 °C
$V_{O\,max}$ = 31kV at I_O = 0
I_O (mA)
3
2
1
0
V_O = 27.5kV
0
25
50
75
100
T_{amb} (°C)
V_O (kV)
40
30
20
10
0
0
1
2
3
4
I_O (mA)

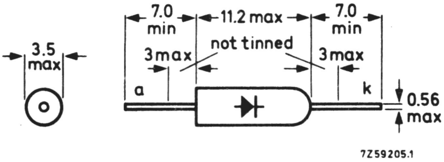
SILICON E.H.T. RECTIFIER DIODE

E.H.T. rectifier diode in a plastic envelope intended for tripler circuits and as focus rectifiers in colour television receivers.
Because of the smallness of the envelope, the diode should be potted when used at voltages above 6 kV.

QUICK REFERENCE DATA

Crest working reverse voltage	V_{RWM}	max.	10	kV
Repetitive peak reverse voltage	V_{RRM}	max.	10	kV
Average forward current	$I_{F(AV)}$	max.	**2.5**	mA
Junction temperature	T_j	max.	85	°C
Recovered charge when switched from I_F = 200 mA to V_R = 100 V with $-\frac{dI}{dt}$ = 200 mA/μs	Q_s	typ.	5	nC

MECHANICAL DATA Dimensions in mm


3.5
max
7.0
min
11.2 max
not tinned
7.0
min
3max
3max
a
k
0.56
max
7Z59205.1

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages 1)

Crest working reverse voltage	V_{RWM}	max.	10	kV
Repetitive peak reverse voltage	V_{RRM}	max.	10	kV
Non-repetitive peak reverse voltage ($t < 10$ ms)	V_{RSM}	max.	10	kV

Currents

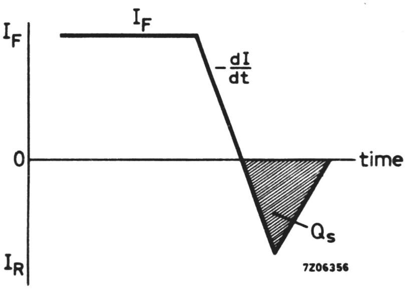
Average forward current (averaged over any 20 ms period)	$I_{F(AV)}$	max.	2.5	mA
Repetitive peak forward current	I_{FRM}	max.	200	mA 2)
Repetitive peak forward current during 20% of vertical deflection period time	I_{FRM}	max.	500	mA 2)
Repetitive peak reverse current during switching off	I_{RRM}	max.	150	mA

Temperatures

Storage temperature	T_{stg}		−55 to +85	°C
Junction temperature	T_j	max.	85	°C

CHARACTERISTICS

Forward voltage at $I_F = 100$ mA; $T_j = 75$ °C	V_F	<	26	V
Reverse current at $V_R = 10$ kV; $T_j = 75$ °C	I_R	<	4.0	μA
Recovered charge when switched from $I_F = 200$ mA to $V_R = 100$ V with $-\frac{dI}{dt} = 200$ mA/μs; $T_j = 25$ °C	Q_s	typ.	5	nC



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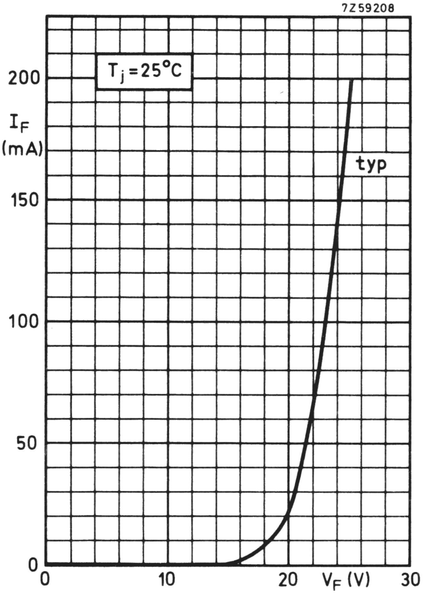
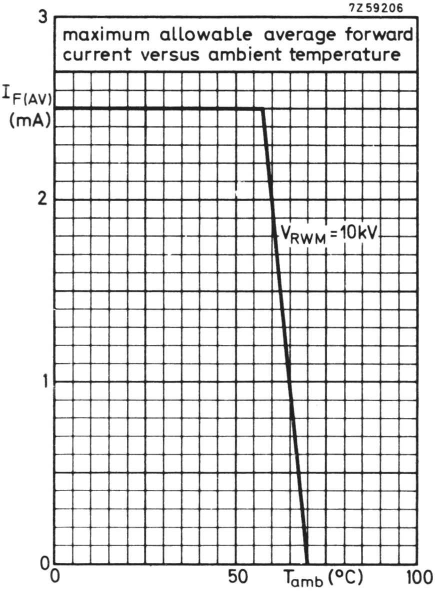
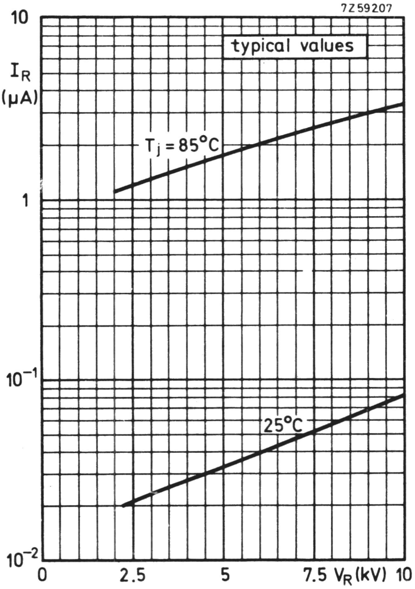
1) During initial line-up a reverse voltage of 11 kV is allowed at $T_{amb} = 50$ °C.
2) The rectifier can withstand flash-over currents in the picture tube.


7Z59208
Tj = 25°C
200
IF
(mA)
150
100
50
0
typ
0
10
20
VF (V)
30

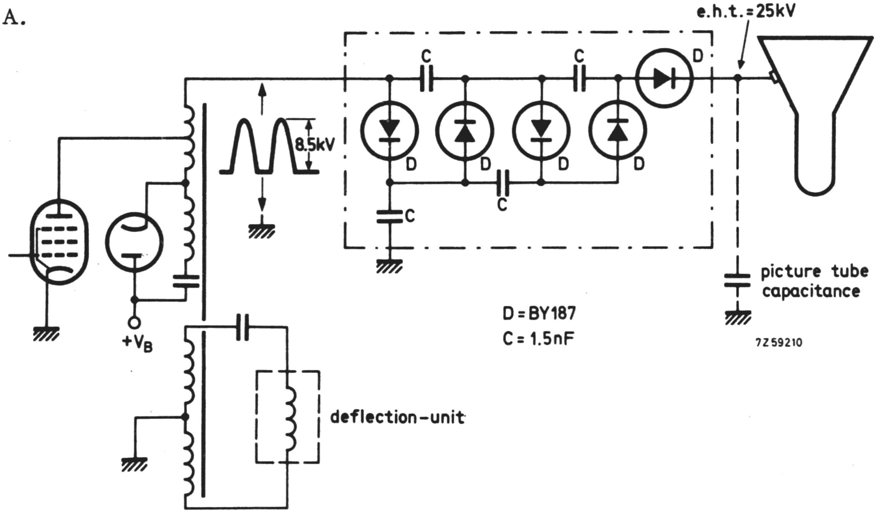

7Z59206
3
maximum allowable average forward current versus ambient temperature
IF(AV)
(mA)
2
1
0
VRWM = 10kV
0
50
Tamb (°C)
100


7Z59207
10
typical values
IR
(μA)
Tj = 85°C
1
10⁻¹
25°C
10⁻²
0
2.5
5
7.5 VR (kV)
10

APPLICATION INFORMATION

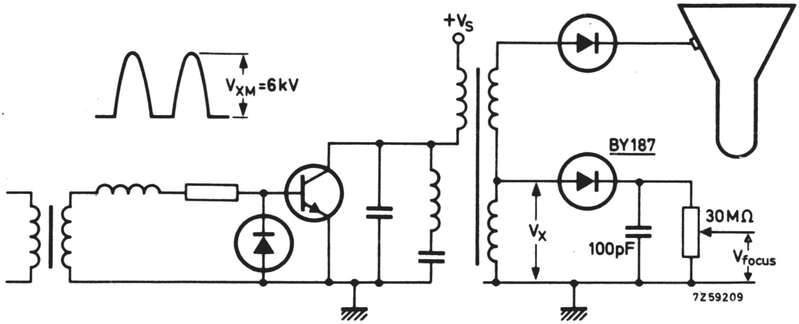
E.H.T. rectifier circuits

A.


e.h.t.=25kV
C
C
D
8.5kV
D
D
D
D
C
C
picture tube capacitance
+V_B
D = BY187
C = 1.5nF
7Z59210
deflection-unit

E.H.T. supply for colour television receivers by means of a tripler circuit employing BY187 diodes. Proper operation of the BY187 diodes is ensured up to an ambient temperature of 70 °C.
Contribution to the regulation of the complete horizontal deflection output circuit due to the tripler system (inside the dashed-lines): 600 kΩ.

B.


+V_S
V_XM=6kV
BY187
30MΩ
V_X
100pF
V_focus
7Z59209

Typical focus supply circuit with BY187 in colour television receivers.
Proper operation of the BY187 is ensured up to an ambient temperature of 70 °C.

SILICON RECTIFIER DIODE

Double diffused silicon diode in a DO-14 plastic envelope for low current rectifier applications.

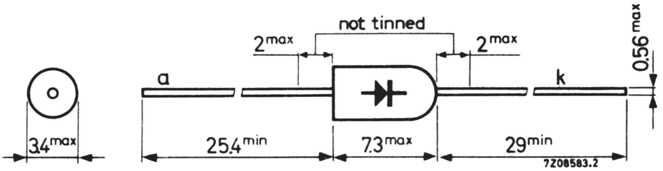
QUICK REFERENCE DATA

Crest working reverse voltage	V_{RWM}	max.	800	V
Repetitive peak reverse voltage	V_{RRM}	max.	1600	V
Average forward current				
R load; $V_{RWM} = V_{RWMmax}$	$I_{F(AV)}$	max.	0.36	A
$V_{RWM} = 60$ V	$I_{F(AV)}$	max.	0.5	A
Non-repetitive peak forward current (t = 10 ms)	I_{FSM}	max.	15	A
Junction temperature	T_j	max.	150	°C

MECHANICAL DATA

Dimensions in mm

DO-14



The sealing of the plastic envelope withstands the accelerated damp heat test of I. E. C. recommendation 68-2 (test D, severity IV, 6 cycles).

MOUNTING METHODS see page 3.

All information applies to frequencies up to 400 Hz.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

Crest working reverse voltage	V_{RWM}	max.	800	V
Repetitive peak reverse voltage ($\delta \leq 0.01$)	V_{RRM}	max.	1600	V
Non-repetitive peak reverse voltage ($t < 10$ ms)	V_{RSM}	max.	1600	V

Currents

Average forward current (averaged over any 20 ms period)				
with R load; $V_{RWM} = V_{RWMmax}$	$I_{F(AV)}$	max.	0.36	A
$V_{RWM} = 60$ V	$I_{F(AV)}$	max.	0.5	A
for capacitive load		see page 4		
Repetitive peak forward current	I_{FRM}	max.	3	A
Non-repetitive peak forward current ($t = 10$ ms; half-sine wave) $T_j = 150\ ^{o}C$ prior to surge	I_{FSM}	max.	15	A

Temperatures

Storage temperature	T_{stg}		-65 to +150	^{o}C
Junction temperature	T_j	max.	150	^{o}C

THERMAL RESISTANCE See page 3

CHARACTERISTICS

Forward voltage

$I_F = 2$ A; $T_j = 25\ ^{o}C$	V_F	<	1.6	V [1]

Peak reverse current

$V_{RM} = 800$ V; $T_j = 125\ ^{o}C$	I_{RM}	<	50	μA

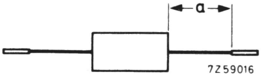
---

[1] Measured under pulsed conditions to avoid excessive dissipation.

THERMAL RESISTANCE (influence of mounting method)

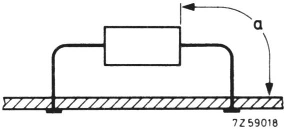
The quoted values apply when no other leads run to the tie-points. If leads of other dissipating components share the same tie-points, the thermal resistance will be higher than that quoted.

1. Mounted to solder tags at a lead-length a = 10 mm. $R_{th\ j-a}$ = 150 °C/W



2. Mounted to solder tags at a = maximum lead-length. $R_{th\ j-a}$ = 200 °C/W

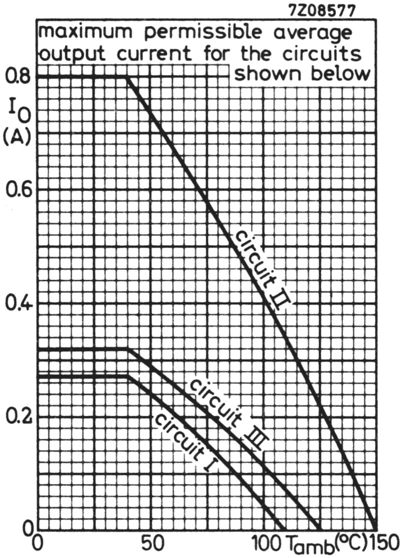
3. Mounted on printed-wiring with a small area of copper at any lead-length a. $R_{th\ j-a}$ = 200 °C/W

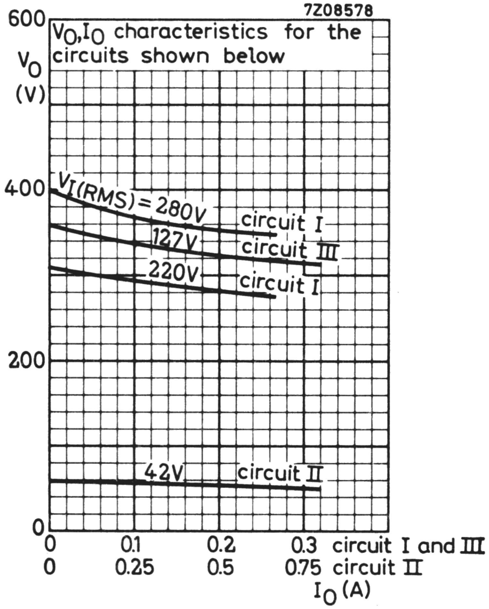


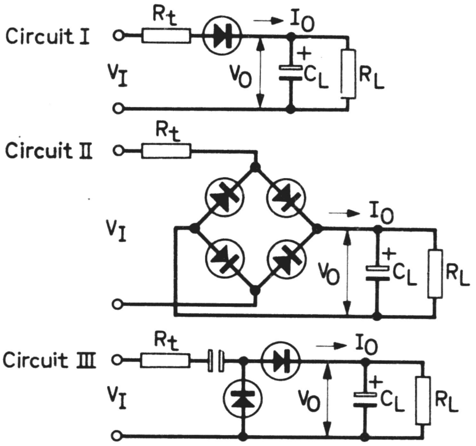
SOLDERING AND MOUNTING NOTES

1. Soldered joints must be at least 5 mm from the seal.
2. The maximum permissible temperature of the soldering iron or bath is 300 °C; it must be in contact with the joint for no more than 3 seconds.
3. Avoid hot spots due to handling or mounting; the body of the device must not come into contact with or be exposed to a temperature higher than 150 °C.

EXAMPLE: Rectifier with C-load
mounting method 1 (see page 3)



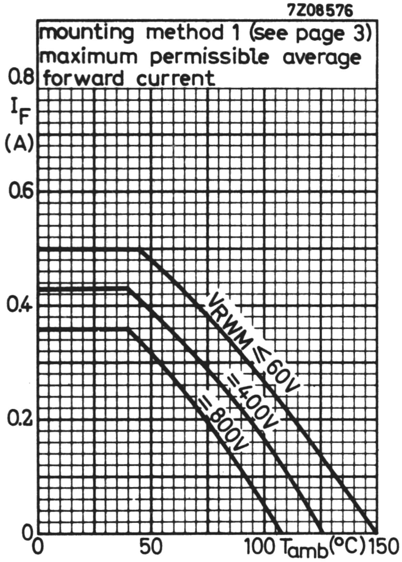


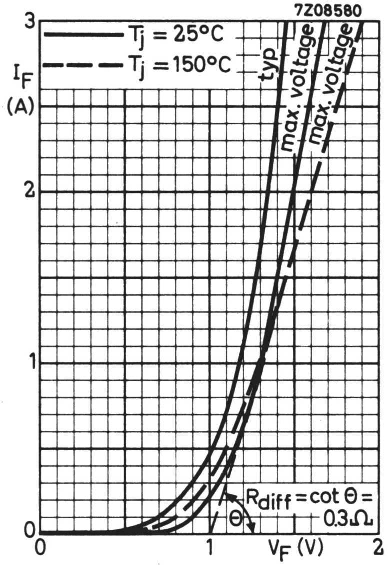

Circuit I
R_t
I_O
V_I
V_O
C_L
R_L
Circuit II
R_t
V_I
I_O
V_O
C_L
R_L
Circuit III
R_t
I_O
V_I
V_O
C_L
R_L

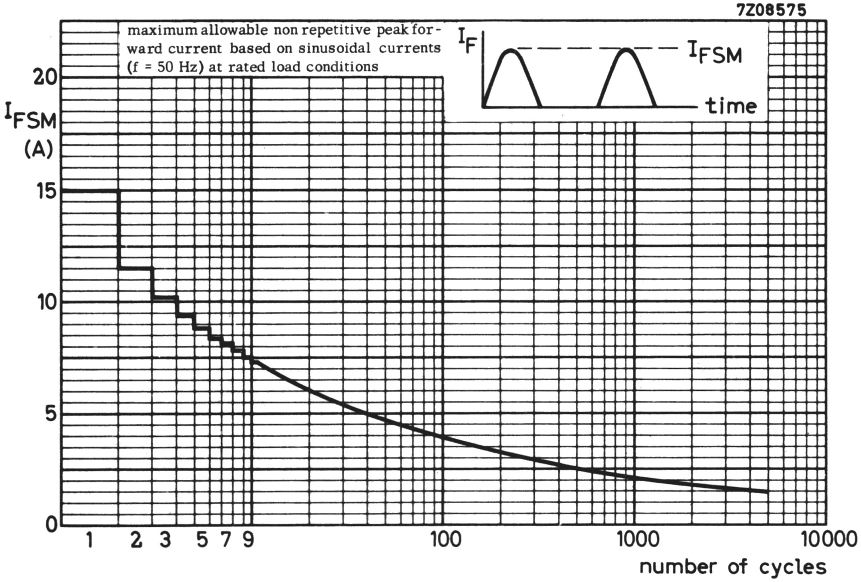
	$V_{I(RMS)}$	R_t	C_L
Circuit I	220V 280V	8.2 Ω 15 Ω	100 μF 100 μF
Circuit II	42V	1.5 Ω	1500 μF
Circuit III	127V	5.6 Ω	200 μF

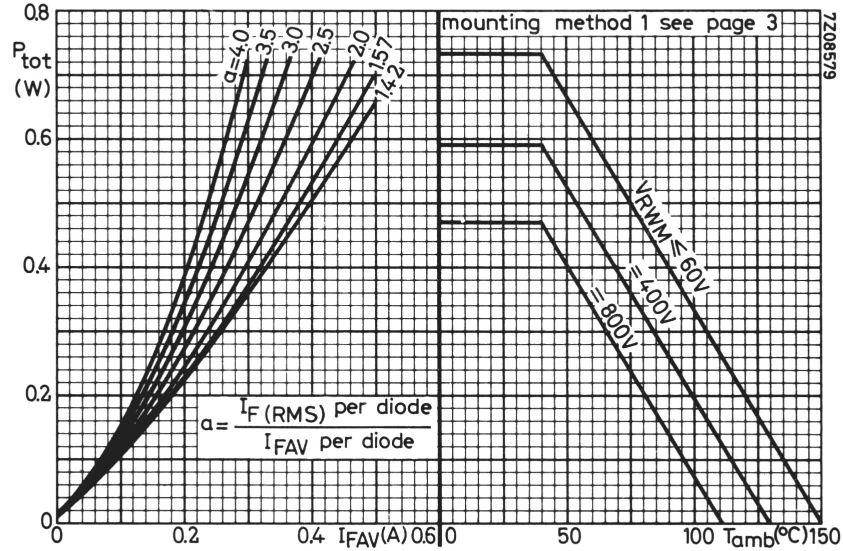
7Z08584

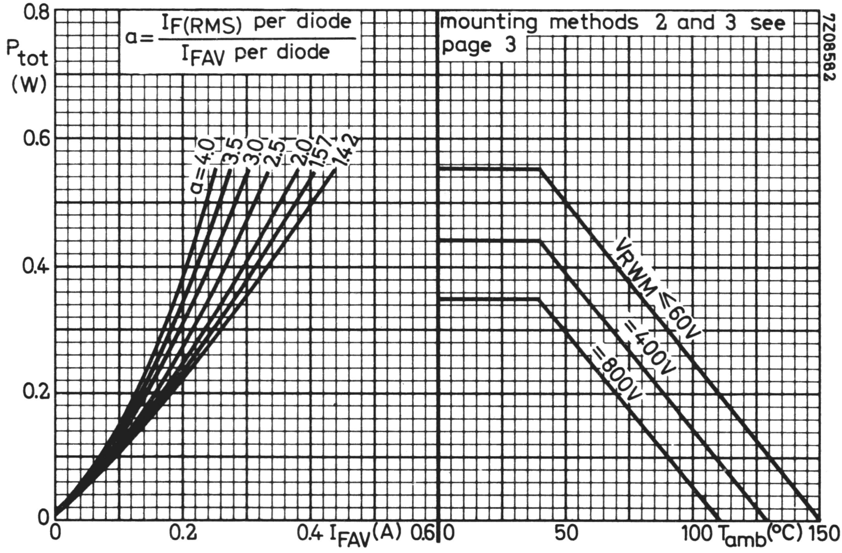
R AND L-LOAD

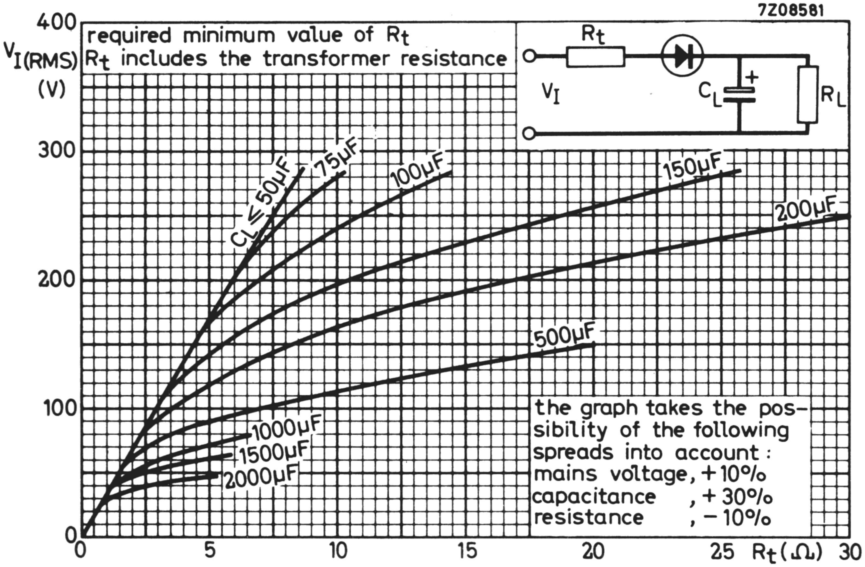

7Z08576
mounting method 1 (see page 3)
maximum permissible average
forward current
I_F
(A)
0.8
0.6
0.4
0.2
0
$V_{RWM} \leq 60V$
= 400V
= 800V
0
50
100
T_{amb} (°C)
150


7Z08580
I_F
(A)
3
2
1
0
$T_j = 25°C$
$T_j = 150°C$
typ
max. voltage
max. voltage
$R_{diff} = \cot \Theta = 0.3 \Omega$
Θ
0
1
V_F (V)
2


7Z08575
maximum allowable non repetitive peak forward current based on sinusoidal currents (f = 50 Hz) at rated load conditions
I_F
I_{FSM}
time
I_{FSM}
(A)
20
15
10
5
0
1
2
3
5
7
9
100
1000
10000
number of cycles


0.8
P_{tot}
(W)
0.6
0.4
0.2
0
0
0.2
0.4
I_{FAV}(A)
0.6
a=4.0
3.5
3.0
2.5
2.0
1.57
1.42
$a = \frac{I_{F(RMS)} \text{ per diode}}{I_{FAV} \text{ per diode}}$
mounting method 1 see page 3
7Z08579
$V_{RWM} \leq 60V$
= 400V
= 800V
0
50
100
T_{amb}(°C)
150


0.8
P_{tot}
(W)
0.6
0.4
0.2
0
0
0.2
0.4
I_{FAV}(A)
0.6
$a = \frac{I_{F(RMS)} \text{ per diode}}{I_{FAV} \text{ per diode}}$
a=4.0
3.5
3.0
2.5
2.0
1.57
1.42
mounting methods 2 and 3 see page 3
7Z08582
$V_{RWM} \leq 60V$
= 400V
= 800V
0
50
100
T_{amb}(°C)
150



From the left hand graph on page 6 the total power dissipation can be found as a function of the average output current.

The parameter $a = \frac{I_{F(RMS)} \text{ per diode}}{I_{FAV} \text{ per diode}}$ depends on $n\omega R_L C_L$ and $\frac{R_t + R_{diff}}{nR_L}$ and can be found from existing graphs.

See **Application Book:** RECTIFIER DIODES
Once the power dissipation is known, the max. permissible ambient temperature follows from the right hand graph.

For the series resistance, added to limit the initial peak rectifier current, the required minimum value can be found from the upper graph.
R_{diff} is shown on page 5 upper figure.

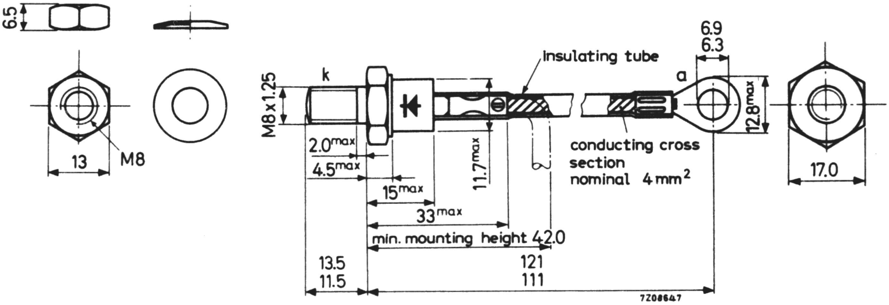
SILICON RECTIFIER DIODES

Double diffused silicon diodes in metal envelopes, intended for power rectifier applications.
The series consists of the following types:
Normal polarity (cathode to stud) BYX13-800 to 1200
Reverse polarity (anode to stud) BYX13-800R to 1200 R

QUICK REFERENCE DATA

			BYX13-800(R)	1000(R)	1200(R)	
Crest working reverse voltage	V_{RWM}	max.	400	500	600	V
Repetitive peak reverse voltage	V_{RRM}	max.	800	1000	1200	V
Average forward current up to T_{mb} = 110 °C	$I_{F(AV)}$	max.	20			A
at T_{mb} = 125 °C	$I_{F(AV)}$	max.	14			A
Non-repetitive peak forward current t = 10 ms; T_j = 125 °C prior to surge	I_{FSM}	max.	400			A
Junction temperature	T_j	max.	150			°C

MECHANICAL DATA Dimensions in mm


6.5
13
M8
k
M8x1.25
2.0max
4.5max
15max
11.7max
33max
min. mounting height 42.0
13.5
11.5
121
111
insulating tube
conducting cross section nominal 4 mm²
6.9
6.3
a
12.8max
17.0
7Z08647

The mark shown applies to normal polarity types and blue cables.

Reverse polarity types: reversed symbol and red cable.

Net weight: 35 g
Diameter of clearance hole: max. 8.5 mm

Torque on nut: min. 40 kg cm
(4 Newton-metres)
max. 60 kg cm
(6 Newton-metres)

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages			BYX13-800(R)	1000(R)	1200(R)	
Continuous reverse voltage	V_R	max.	400	500	600	V
Crest working reverse voltage	V_{RWM}	max.	400	500	600	V
Repetitive peak reverse voltage ($\delta \leq 0.01$)	V_{RRM}	max.	800	1000	1200	V
Non-repetitive peak reverse voltage ($t < 10$ ms)	V_{RSM}	max.	800	1000	1200	V

Currents				
Average forward current (averaged over any 20 ms period) up to $T_{mb} = 110\ ^oC$	$I_{F(AV)}$	max.	20	A
at $T_{mb} = 125\ ^oC$	$I_{F(AV)}$	max.	14	A
Repetitive peak forward current	I_{FRM}	max.	100	A
Non-repetitive peak forward current ($t = 10$ ms; half sine wave) $T_j = 125\ ^oC$ prior to surge	I_{FSM}	max.	400	A
I squared t for fusing ($t = 10$ ms)	I^2t	max.	570	A^2s

Temperatures				
Storage temperature	T_{stg}		−65 to +150	^oC
Junction temperature	T_j	max.	150	^oC

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.1	$^oC/W$
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.3	$^oC/W$

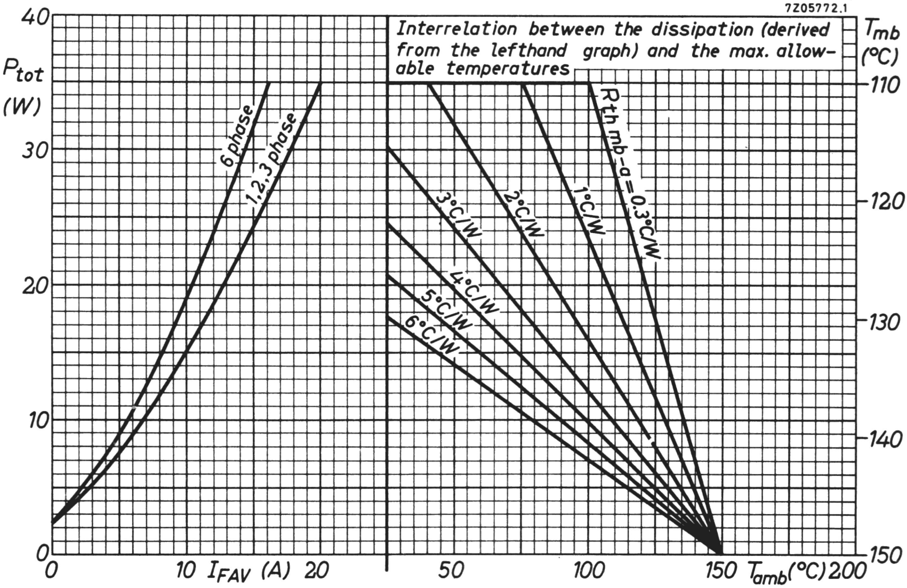
CHARACTERISTICS

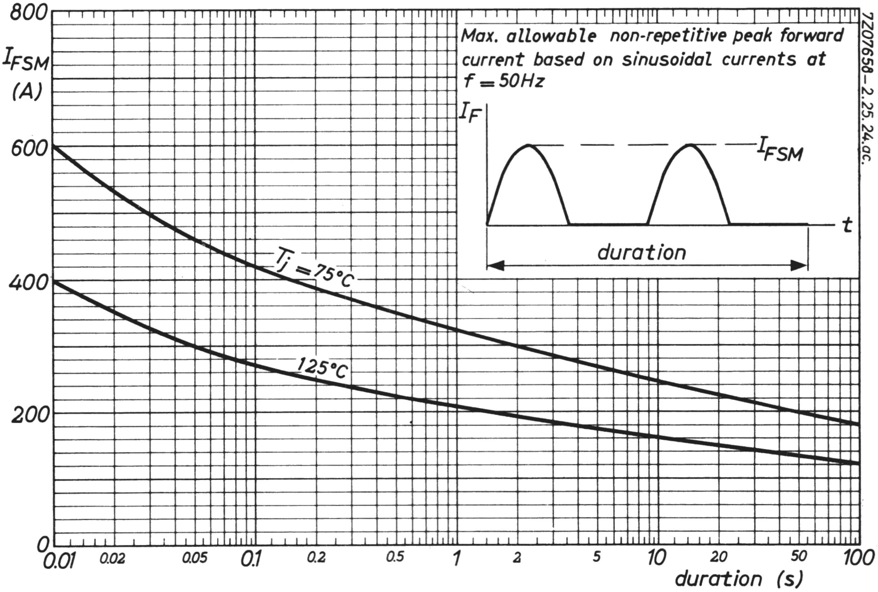
Forward voltage at $T_j = 25\ ^oC$				
$I_F = 1$ A	V_F	<	0.9	V
$I_F = 100$ A	V_F	<	2.0	V 1)

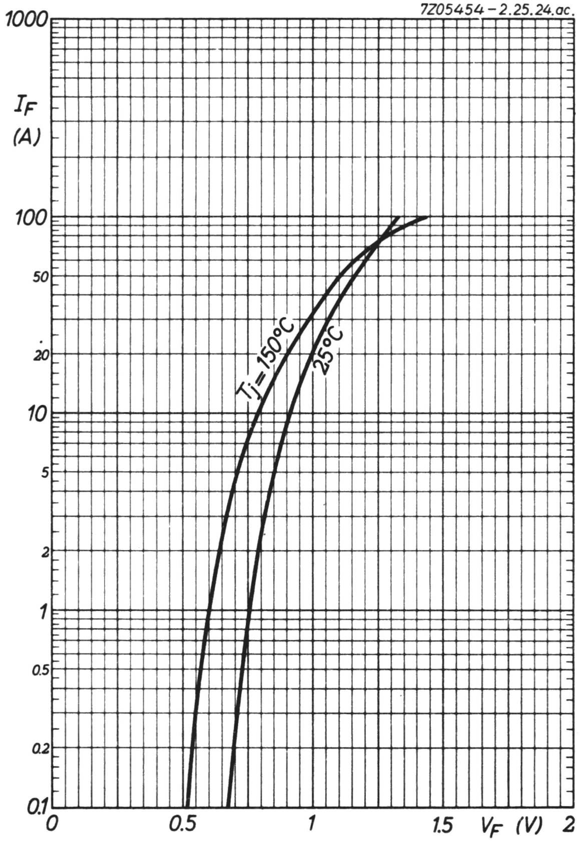
Peak reverse current			BYX13-800(R)	1000(R)	1200(R)
$V_{RM} = V_{RWMmax}$; $T_j = 125\ ^oC$	I_{RM}	<	2.0	1.7	1.4 mA

---

1) Measured under pulsed conditions to avoid excessive dissipation.


7Z05772.1
Interrelation between the dissipation (derived from the lefthand graph) and the max. allowable temperatures
P_{tot} (W)
40
30
20
10
0
0
10
I_{FAV} (A)
20
6 phase
1,2,3 phase
50
100
150
T_{amb} (°C)
200
T_{mb} (°C)
110
120
130
140
150
$R_{th\,mb-a}$ = 0.3°C/W
1°C/W
2°C/W
3°C/W
4°C/W
5°C/W
6°C/W


7Z07658–2.25.24.ac.
Max. allowable non-repetitive peak forward current based on sinusoidal currents at f = 50Hz
I_F
I_{FSM}
t
duration
I_{FSM} (A)
800
600
400
200
0
T_j = 75°C
125°C
0.01
0.02
0.05
0.1
0.2
0.5
1
2
5
10
20
50
100
duration (s)



APPLICATION INFORMATION AND OPERATING NOTES

See general pages at the beginning of this section.

SILICON RECTIFIER DIODES

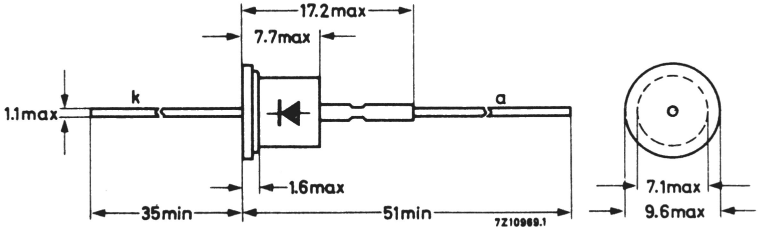
The BYX22-600 and BYX22-1200 are silicon diodes in a metal DO-1 envelope, intended for power rectifier applications up to 1.4 A.

QUICK REFERENCE DATA

			BYX22-600	1200	
Crest working reverse voltage	V_{RWM}	max.	400	800	V
Repetitive peak reverse voltage	V_{RRM}	max.	600	1200	V
Average forward current	I_{FAV}	max.	1.4		A
Non-repetitive peak forward current t = 10 ms; T_j = 150 °C	I_{FSM}	max.	40		A
Junction temperature	T_j	max.	150		°C
Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	60		°C/W

MECHANICAL DATA Dimensions in mm

DO-1



MOUNTING METHODS see page 3

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

All information applies to frequencies up to 400Hz

Voltages

			BYX22-600	1200	
Crest working reverse voltage	V_{RWM}	max.	400	800	V
Repetitive peak reverse voltage ($d \leq 1\%$)	V_{RRM}	max.	600	1200	V
Non repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	600	1200	V

Currents

Average forward current (averaged over any 20 ms period) for R-load up to $T_{amb} = 30\,^{o}C$	I_{FAV}	max.	1.4	A
Forward current (d.c.) up to $T_{amb} = 30\,^{o}C$	I_F	max.	1.6	A
Repetitive peak forward current	I_{FRM}	max.	15	A
Non repetitive peak forward current $t = 10$ ms; $T_j = 150\,^{o}C$ (see page 6)	I_{FSM}	max.	40	A

Temperatures

Storage temperature	T_{stg}		-65 to +150	^{o}C
Ambient temperature	T_{amb}	max.	150	^{o}C

THERMAL RESISTANCE

From junction to ambient	$R_{th\,j\text{-}a}$	See page 3

CHARACTERISTICS

Forward voltage at $I_F = 5A$; $T_{amb} = 25\,^{o}C$	V_F	<	1.5	V [1]
Reverse current at $V_R = V_{RWMmax}$; $T_{amb} = 125^{o}C$	I_R	<	120	μA

---

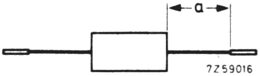
[1]) Measured under pulsed conditions to avoid excessive dissipation.

THERMAL RESISTANCE

Effect of mounting on thermal resistance $R_{th\ j-a}$

The quoted values apply when no other leads run to the tie-points. If leads of other dissipating components share the same tie-points, the thermal resistance will be higher than that quoted.

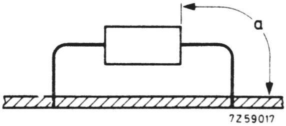
1. Mounted to solder tags at a lead-length a = 10 mm. $R_{th\ j-a}$ = 60 °C/W



2. Mounted to solder tags at a = maximum lead-length. $R_{th\ j-a}$ = 70 °C/W

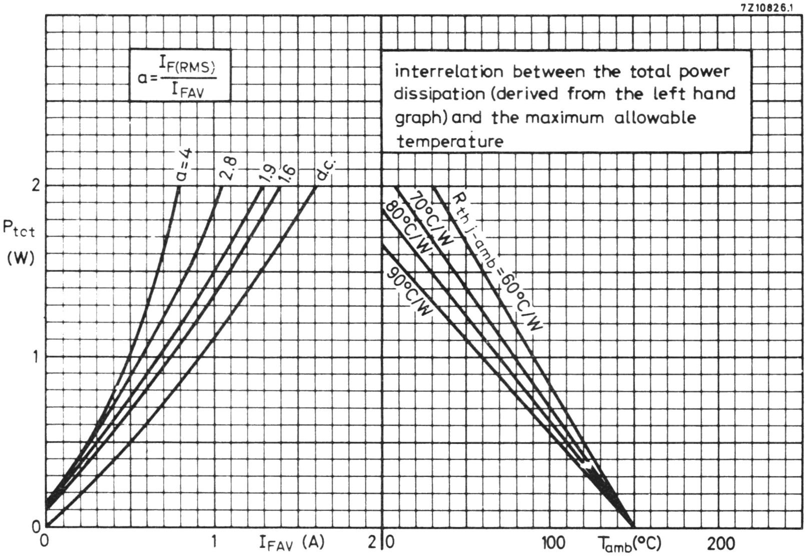
3. Mounted on printed-wiring board at a = maximum lead-length. $R_{th\ j-a}$ = 80 °C/W

4. Mounted on printed-wiring board at a lead-length a = 10 mm. $R_{th\ j-a}$ = 90 °C/W



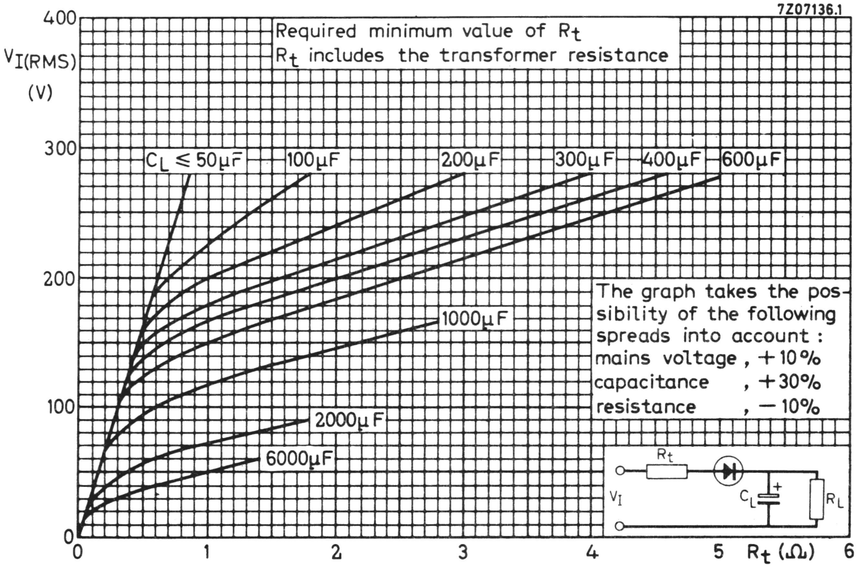
SOLDERING AND MOUNTING NOTES

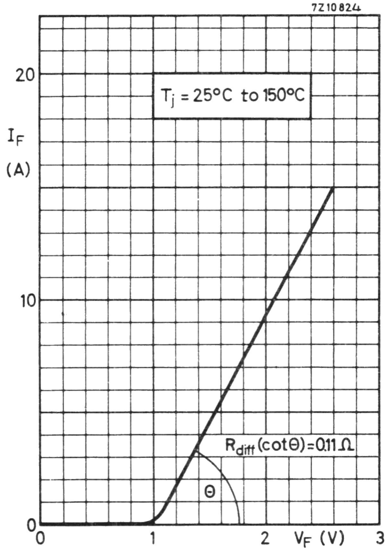
1. At a soldering iron or bath temperature of up to 245 °C, the maximum permissible soldering time is 10 s if the joint is 5 mm from the seal, 3 s if it is 1.5 mm from the seal.
2. At a temperature between 245 °C and 400 °C (max.), the joint must be more than 5 mm from the seal and soldering time must not exceed 5 s.
3. Leads should not be bent less than 1.5 mm from the seal; excert no axial pull when bending.

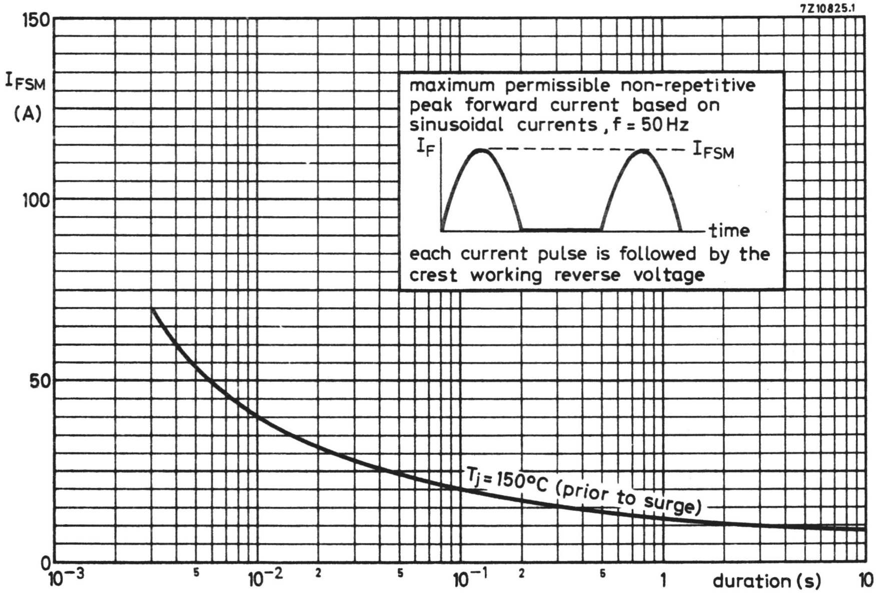


The form factor $a = \frac{I_{F(RMS)} \text{ per diode}}{I_{FAV} \text{ per diode}}$ depends on $n\omega R_L C_L$ and $\frac{R_t + R_{diff}}{nR_L}$ and can be found from existing graphs.

See Application Book: RECTIFIER DIODES.


7Z07136.1
Required minimum value of R_t
R_t includes the transformer resistance
$V_{I(RMS)}$ (V)
400
300
200
100
0
$C_L \leq 50\mu F$
100µF
200µF
300µF
400µF
600µF
1000µF
2000µF
6000µF
The graph takes the possibility of the following spreads into account :
mains voltage , +10%
capacitance , +30%
resistance , −10%
R_t
V_I
C_L
+
R_L
0
1
2
3
4
5
R_t (Ω)
6


7Z10824
T_j = 25°C to 150°C
I_F (A)
20
10
0
$R_{diff}(\cot\Theta)$=0.11Ω
Θ
0
1
2
V_F (V)
3


7Z10825.1
150
100
50
0
I_{FSM}
(A)
maximum permissible non-repetitive peak forward current based on sinusoidal currents, f = 50 Hz
I_F
I_{FSM}
time
each current pulse is followed by the crest working reverse voltage
T_j = 150°C (prior to surge)
10^{-3}
5
10^{-2}
2
5
10^{-1}
2
5
1
duration (s)
10

CONTROLLED AVALANCHE RECTIFIER DIODES

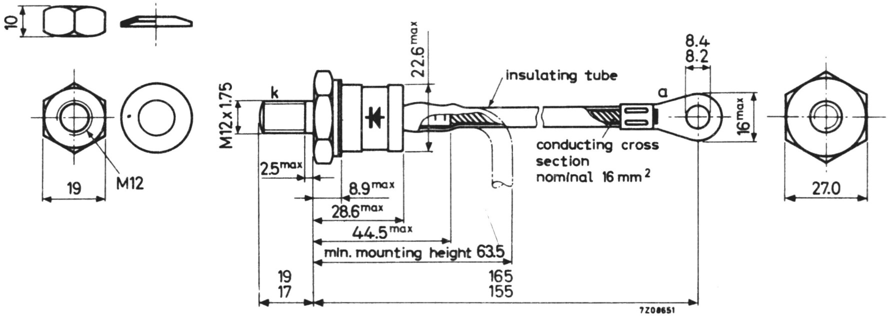
Diffused silicon diodes in metal envelopes with ceramic insulation, capable of absorbing transients and intended for power rectifier application.
The series consists of normal polarity types (cathode to stud) BYX23-400 to -1000.

QUICK REFERENCE DATA

			BYX23 – 400	600	800	1000	
Crest working reverse voltage	V_{RWM}	max.	400	600	800	1000	V
Reverse avalanche breakdown voltage	$V_{(BR)R}$	>	500	750	1000	1250	V
Average forward current up to $T_{mb} = 100\ ^{o}C$	$I_{F(AV)}$	max.	150				A
at $T_{mb} = 125\ ^{o}C$	$I_{F(AV)}$	max.	115				A
Non-repetitive peak forward current $t = 10$ ms; $T_j = 190\ ^{o}C$ prior to surge	I_{FSM}	max.	1600				A
Non-repetitive peak reverse power dissipation ($t = 10\ \mu s$; $T_j = 25\ ^{o}C$)	P_{RSM}	max.	30				kW
Operating junction temperature	T_j	max.	190				^{o}C

MECHANICAL DATA

Dimensions in mm


10
19
M12
M12x1.75
k
2.5max
8.9max
28.6max
44.5max
min. mounting height 63.5
19
17
165
155
22.6max
insulating tube
conducting cross section nominal 16 mm²
a
8.4
8.2
16max
27.0
7Z08651

Net weight: 115 g
Diameter of clearance hole: max. 13.0 mm

Torque on nut: min. 100 kg cm
(10 Newton-metres)
max. 250 kg cm
(25 Newton-metres)

All information applies to frequencies up to 400 Hz.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages [1]

			BYX23 – 400	600	800	1000	
Continuous reverse voltage	V_R	max.	400	600	800	1000	V
Crest working reverse voltage	V_{RWM}	max.	400	600	800	1000	V

Currents

Average forward current (averaged over any 20 ms period) up to $T_{mb} = 100\,^{o}C$	$I_{F(AV)}$	max	150	A
at $T_{mb} = 125\,^{o}C$	$I_{F(AV)}$	max.	115	A
Forward current (d. c.)	I_F	max.	240	A
R. M. S. forward current	$I_{F(RMS)}$	max.	240	A
Repetitive peak forward current	I_{FRM}	max.	750	A
Non-repetitive peak forward current (t = 10 ms; half sine wave) $T_j = 190\,^{o}C$ prior to surge	I_{FSM}	max.	1600	A
I squared t for fusing (t = 10 ms)	I^2t	max.	12800	A^2s

Reverse power dissipation

Average reverse power dissipation (averaged over any 20 ms period)	$P_{R(AV)}$	max.	30	W
Repetitive peak reverse power dissipation $t = 10\,\mu s$ (square wave; f = 50 Hz) $T_j = 190\,^{o}C$	P_{RRM}	max.	8	kW
Non-repetitive peak reverse power dissipation; t = 10 µs (square wave) **see page 5** $T_j = 25\,^{o}C$ prior to surge	P_{RSM}	max.	30	kW
$T_j = 190\,^{o}C$ prior to surge	P_{RSM}	max.	15	kW

Temperatures

Storage temperature	T_{stg}		-55 to +200	^{o}C
Operating junction temperature	T_j	max.	190	^{o}C

---

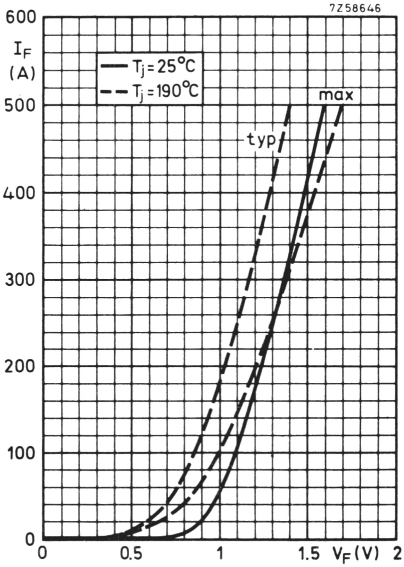
[1] To ensure thermal stability: $R_{th\ j\text{-}a} < 0.75\,^{o}C/W$ (continuous reverse voltage) or $< 1.5\,^{o}C/W$ (a.c.).
For smaller heatsinks T_j should be derated. For a.c. see page 5 upper **graph.**
For continuous reverse voltage: $R_{th\ j\text{-}a} = 1\,^{o}C/W$, then $T_{j\,max} = 184\,^{o}C$
$R_{th\ j\text{-}a} = 1.2\,^{o}C/W$, then $T_{j\,max} = 180\,^{o}C$
$R_{th\ j\text{-}a} = 1.5\,^{o}C/W$, then $T_{j\,max} = 175\,^{o}C$

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	0.4	°C/W
From mounting base to heatsink				
without heatsink compound	$R_{th\ mb\text{-}h}$	=	0.1	°C/W
with heatsink compound (e.g. Dow Corning 340)	$R_{th\ mb\text{-}h}$	=	0.04	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.025	°C/W

CHARACTERISTICS

			BYX23 – 400	600	800	1000	
Forward voltage I_F = 500 A; T_j = 25 °C	V_F	<	1.6	1.6	1.6	1.6	V[1]
Reverse avalanche breakdown voltage I_R = 10 mA; T_j = 25 °C	$V_{(BR)R}$	>	500	750	1000	1250	V
		<	1600	1600	1600	1600	V
Peak reverse current $V_{RM} = V_{RWM\,max}$; T_j = 175 °C	I_{RM}	<	30	24	18	15	mA



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[1] Measured under pulsed conditions to avoid excessive dissipation.

OPERATING NOTES (see also general pages at the beginning of this section)

1. Voltage sharing of series connected controlled avalanche diodes.

   When diodes with avalanche characteristics are connected in series, the usual R and C elements for voltage sharing can be omitted.

2. Switching transients for controlled avalanche diodes.

   In an unloaded rectifier circuit, when the transformer is switched off, energy is released.
   When, as a result, no diode rating is exceeded, special provisions are not needed. If, however, the rated non-repetitive peak power dissipation per device could be exceeded, damping across the transformer is necessary in order to protect the device.

   The duration of the transformer's energy release can be found in first approximation from the empirical formula:

$$t \approx \frac{V_{RWM}}{V_{(BR)R\,min}}\ ;\ \text{(milliseconds)}$$

where V_{RWM} = actually applied crest working voltage

$V_{(BR)R\,min}$ = minimum reverse breakdown voltage

The non-repetitive peak power that can be absorbed by a single device during t ms can be derived from the graph on page 5. Multiplying that amount with the time in which it is released results in the energy absorbed by one diode. (E_D).
A series string of n diodes can absorb n times as much. ($n.E_D$)

The difference between the energy released by the transformer and that absorbed by the n diodes should be absorbed by series connected R and C elements across the secondary winding of the transformer.
The magnitudes of R and C have to be derived from the following formulae:

$$C = \frac{E_T - n.E_D}{(n.V_{(BR)R\,min})^2} \cdot 10^6 \quad (\mu F) \qquad R = \frac{310}{C} \quad (\Omega)$$

where C = capacitance in µF

E_T = energy released by the transformer in Ws

n = number of diodes in series

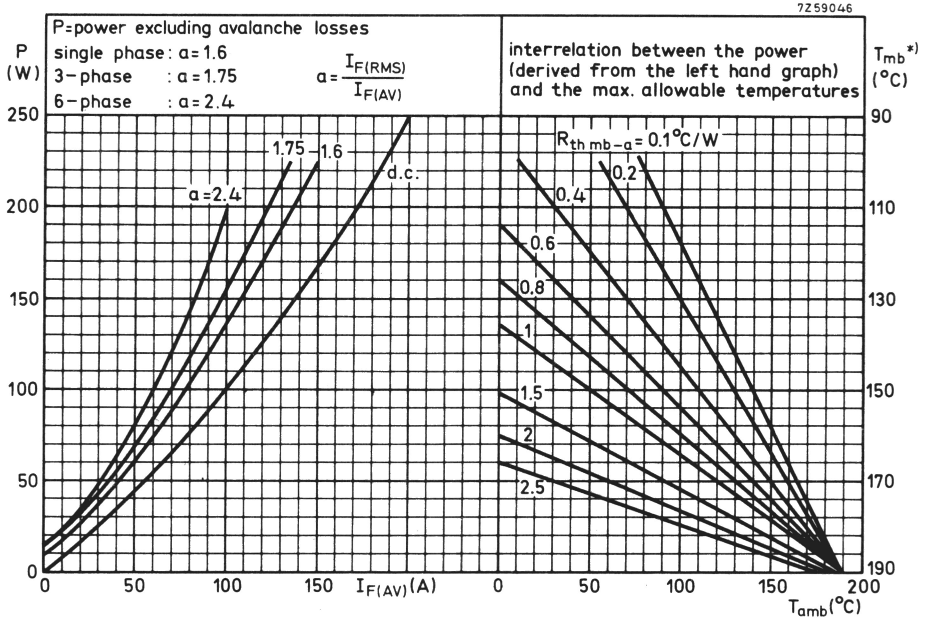
E_D = energy absorbed by one diode in Ws

$V_{(BR)R\,min}$ = minimum reverse breakdown voltage of one diode in V

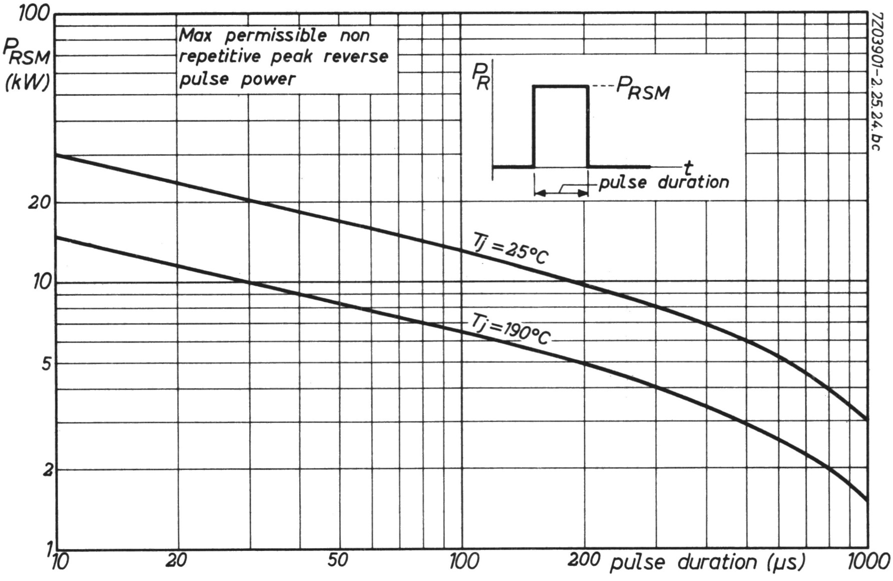
R = resistance in Ω

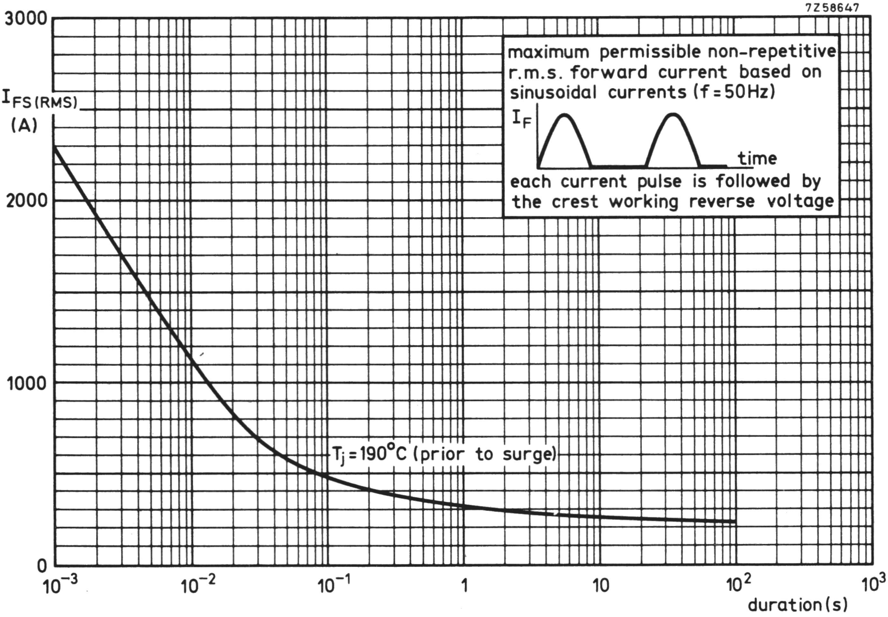
APPLICATION INFORMATION

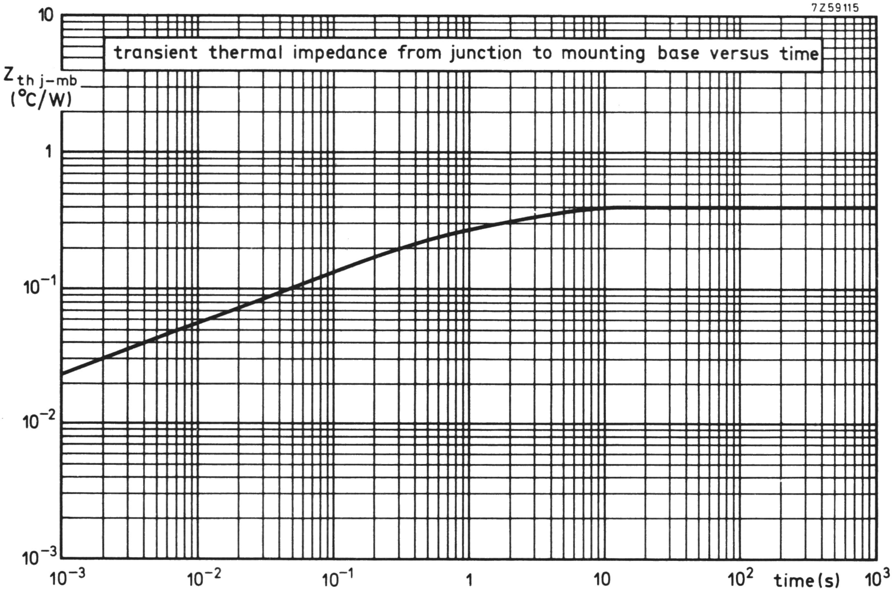
See general pages at the beginning of this section.



*) T_{mb}-scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leq 1.1$ °C/W




7Z58647
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50Hz)
I_F
time
each current pulse is followed by the crest working reverse voltage
I_{FS(RMS)} (A)
3000
2000
1000
0
T_j = 190°C (prior to surge)
10^{−3}
10^{−2}
10^{−1}
1
10
10²
10³
duration (s)


7Z59115
transient thermal impedance from junction to mounting base versus time
Z_{th j-mb} (°C/W)
10
1
10^{−1}
10^{−2}
10^{−3}
10^{−3}
10^{−2}
10^{−1}
1
10
10²
time (s)
10³

CONTROLLED AVALANCHE RECTIFIER DIODES

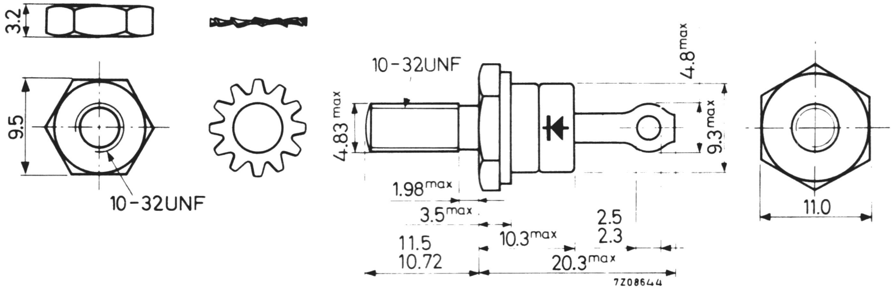
Diffused silicon diodes in a DO-4 metal envelope, capable of absorbing transients and intended for power rectifier applications.
The series consists of the following types:
Normal polarity (cathode to stud): BYX25-600 to 1000.
Reverse polarity (anode to stud): BYX25-600R to 1000R.

QUICK REFERENCE DATA

			BYX25-600(R)	800(R)	1000(R)	
Crest working reverse voltage	V_{RWM}	max.	600	800	1000	V
Reverse avalanche breakdown voltage	$V_{(BR)R}$	>	750	1000	1250	V
Average forward current	$I_{F(AV)}$	max.	20			A
Non-repetitive peak forward current $t = 10$ ms; $T_j = 175\,^{o}C$ prior to surge	I_{FSM}	max.	360			A
Non-repetitive peak reverse power dissipation ($t = 10\,\mu s$; $T_j = 25\,^{o}C$)	P_{RSM}	max.	18			kW
Junction temperature	T_j	max.	175			^{o}C

MECHANICAL DATA Dimensions in mm

DO-4



Net weight: 7.6 g
Diameter of clearance hole: max. 5.2 mm
Accessories supplied on request: 56295, (56262A)
The mark shown applies to the normal polarity types

Torque on nut: min. 8 kgcm
(0.8 Newton-metres)
max. 17 kgcm
(1.7 Newton-metres)

All information applies to frequencies up to 400 Hz

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages [1]

			BYX25-600(R)	800(R)	1000(R)	
Continuous reverse voltage	V_R	max.	600	800	1000	V
Crest working reverse voltage	V_{RWM}	max.	600	800	1000	V

Currents

Average forward current (averaged over any 20 ms period)	$I_{F(AV)}$	max.	20	A
Forward current (d.c.)	I_F	max.	25	A
Repetitive peak forward current	I_{FRM}	max.	440	A
Non-repetitive peak forward current (t = 10 ms; half sine wave) $T_j = 175\ ^\circ C$ prior to surge	I_{FSM}	max.	360	A

Reverse power dissipation

Average reverse power dissipation (averaged over any 20 ms period) $T_j = 175^\circ C$	$P_{R(AV)}$	max.	38	W
Repetitive peak reverse power dissipation $t = 10\ \mu s$ (square wave; f = 50 Hz) $T_j = 175^\circ C$	P_{RRM}	max.	3.0	kW
Non-repetitive peak reverse power dissipation $t = 10\ \mu s$ (square wave) $T_j = 25\ ^\circ C$ prior to surge	P_{RSM}	max.	18	kW
$T_j = 175\ ^\circ C$ prior to surge	P_{RSM}	max.	3.0	kW

Temperatures

Storage temperature	T_{stg}		−55 to +175	°C
Junction temperature	T_j	max.	175	°C

---

[1] To ensure thermal stability: $R_{th\ j\text{-}a} < 2.5\ ^\circ C/W$ (d.c.) or $< 5\ ^\circ C/W$ (a.c.)
For smaller heatsinks $T_{j\,max.}$ should be derated. For a.c. see page 5).
For d.c.: if $R_{th\ j\text{-}a} = 5\ ^\circ C/W$, then $T_{j\ max.} = 135\ ^\circ C$,
if $R_{th\ j\text{-}a} = 10\ ^\circ C/W$, then $T_{j\ max.} = 129\ ^\circ C$.

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	50	°C/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.3	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.5	°C/W

CHARACTERISTICS

			BYX25-600(R)	800(R)	1000(R)	
Forward voltage						
I_F = 50 A; T_j = 25 °C	V_F	<	1.8	1.8	1.8	V[1]
Reverse avalanche breakdown voltage						
I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	>	750	1000	1250	V
		<	2000	2000	2000	V ←
Peak reverse current						
$V_{RM} = V_{RWM\,max}$; T_j = 125 °C	I_{RM}	<	1.0	0.8	0.6	mA

APPLICATION INFORMATION

See general pages at the beginning of this section

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[1] Measured under pulsed conditions to avoid excessive dissipation.

OPERATING NOTES (See also general pages at the beginning of this section.)

1. Voltage sharing of series connected controlled avalanche diodes.

   If diodes with avalanche characteristics are connected in series, the usual R and C elements for voltage sharing can be omitted.

2. The top connector should not be bent; it should be soldered into the circuit so that there is no strain on it.

   During soldering the heat conduction to the junction should be kept to a minimum by using a thermal shunt.

Determination of the heatsink thermal resistance.

Example:

Assume a diode, used in a three phase rectifier circuit.

frequency	f	= 50 Hz
average forward current	I_{FAV}	= 10 A (per diode)
ambient temperature	T_{amb}	= 40 °C
repetitive peak reverse power dissipation in the avalanche region	P_{RRM}	= 2 kW(per diode)
duration of P_{RRM}	t	= 40 μs

From the left hand part of the upper graph on page 5 it follows that at $I_{FAV} = 10$ A in a three phase rectifier circuit the average forward power + average leakage power = 19.5 W per diode (point A). The average reverse power in the avalanche region, averaged over any cycle, follows from:

$$P_{RAV} = \delta \times P_{RRM}, \text{ where the duty cycle } \delta = \frac{40\ \mu s}{20\ ms} = 0.002$$

Thus: $P_{RAV} = 0.002 \times 2\ kW = 4\ W$

Therefore the total device power dissipation $P_{tot} = (19.5 + 4)\ W = 23.5\ W$ (point B). In order to avoid excessive peak junction temperatures resulting from the pulse character of the repetitive peak reverse power in the avalanche region, the value of the maximum junction temperature should be reduced. If the repetitive peak reverse power in the avalanche region is 2 kW; t = 40 μs; f = 50 Hz, the maximum allowable junction temperature should be 163 °C instead of 175 °C, thus 12 °C lower (see the lower graph on page 5).

Allowance can be made for this by assuming an ambient temperature 12 °C higher than before, in this case 52 °C instead of 40 °C.

Using this in the curve leads to a thermal resistance

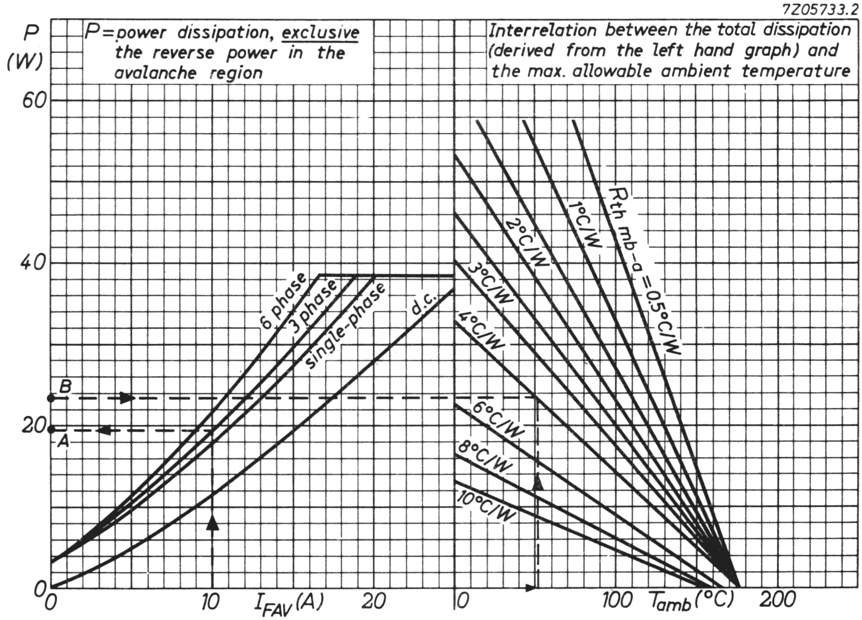
$$R_{th\ mb-a} \approx 4\ {}^{o}C/W$$

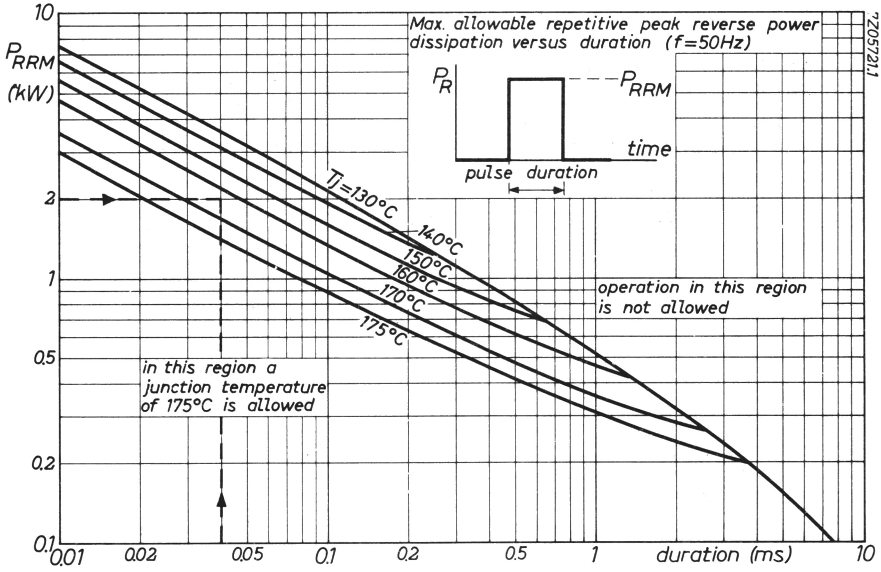
The contact thermal resistance $R_{th\ mb-h} = 0.5\ {}^{o}C/W$

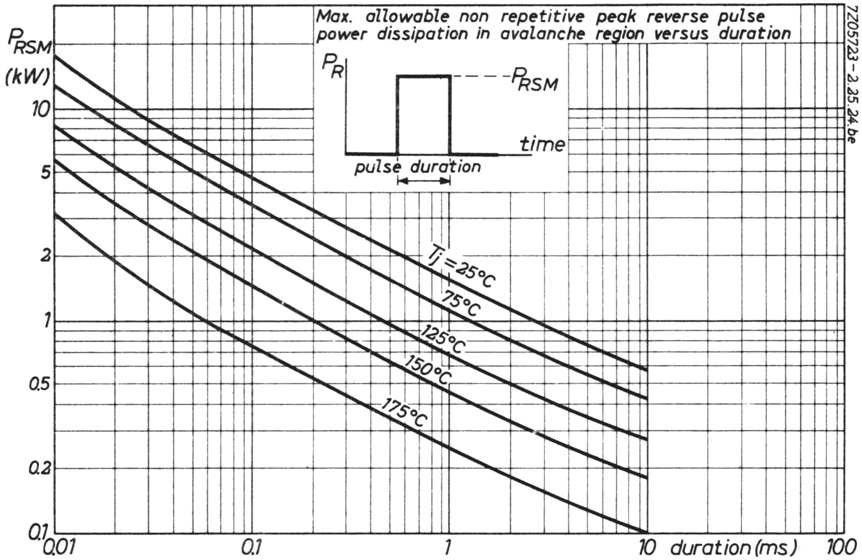
Hence the heatsink thermal resistance should be:

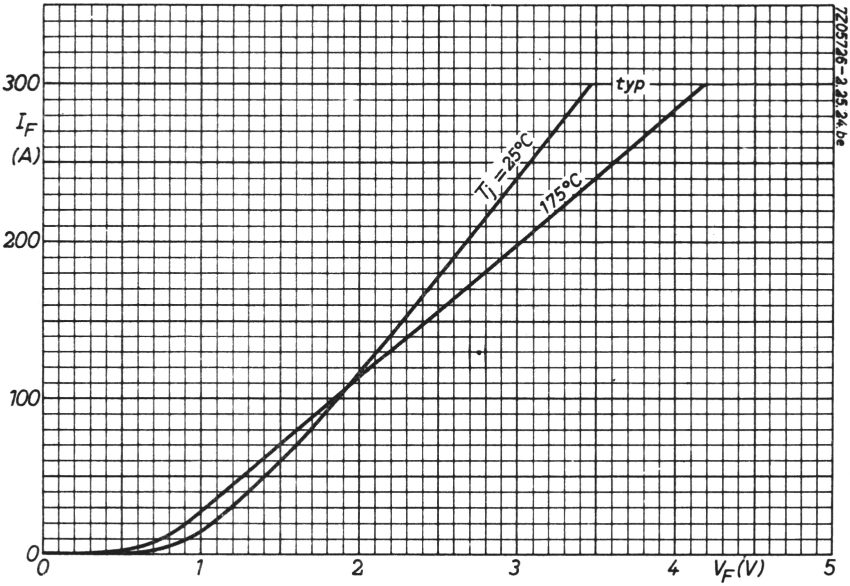
$$R_{th\ h-a} = R_{th\ mb-a} - R_{th\ mb-h} = (4 - 0.5)\ {}^{o}C/W = 3.5\ {}^{o}C/W$$

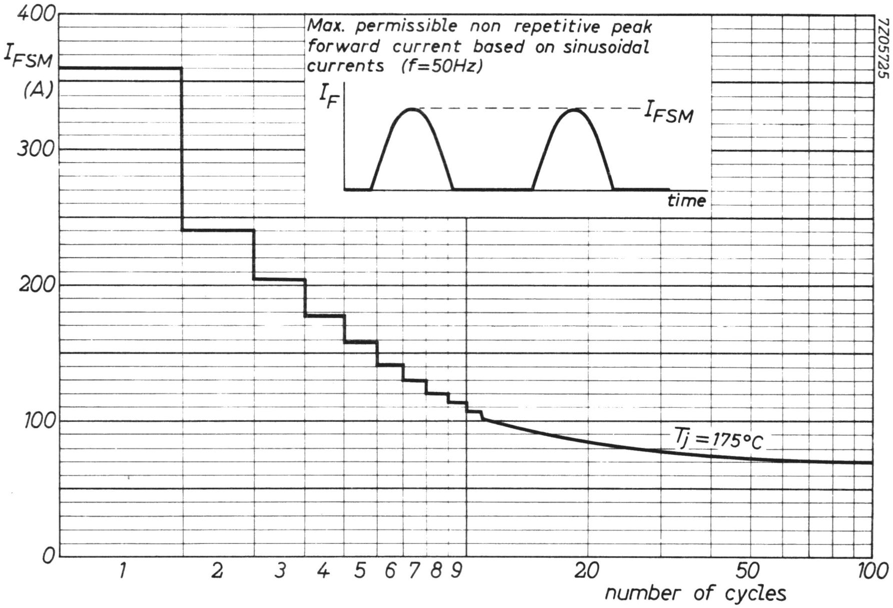
The applicable heatsink(s) may then be found in the Section HEATSINKS.

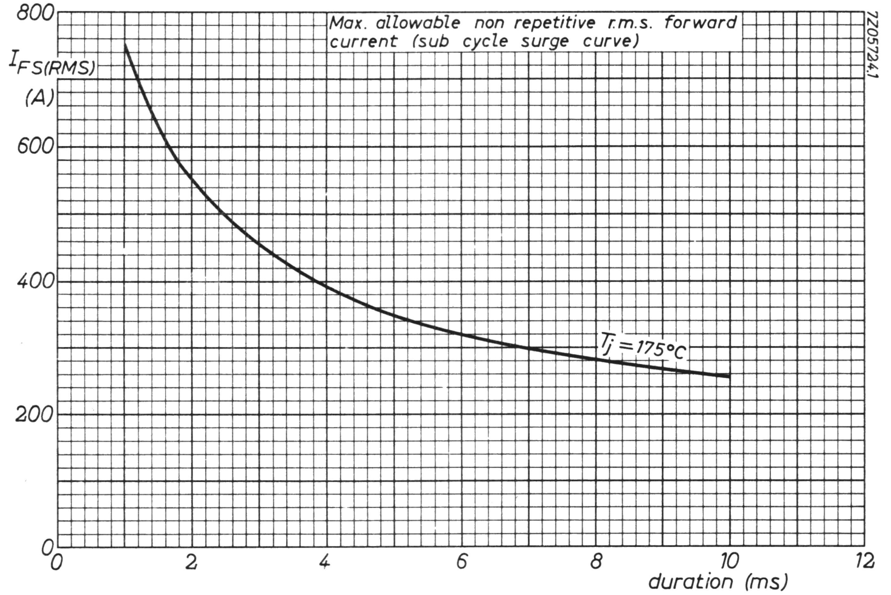

7Z05733.2
P
(W)
P = power dissipation, exclusive the reverse power in the avalanche region
Interrelation between the total dissipation (derived from the left hand graph) and the max. allowable ambient temperature
60
40
20
0
B
A
6 phase
3 phase
single-phase
d.c.
$R_{th\,mb-a}$ = 0.5°C/W
1°C/W
2°C/W
3°C/W
4°C/W
6°C/W
8°C/W
10°C/W
0
10
I_{FAV} (A)
20
0
100
T_{amb} (°C)
200


7Z05721.1
10
P_{RRM}
(kW)
2
1
0.5
0.2
0.1
Max. allowable repetitive peak reverse power dissipation versus duration (f=50Hz)
P_R
P_{RRM}
time
pulse duration
T_j = 130°C
140°C
150°C
160°C
170°C
175°C
operation in this region is not allowed
in this region a junction temperature of 175°C is allowed
0.01
0.02
0.05
0.1
0.2
0.5
1
duration (ms)
10


Max. allowable non repetitive peak reverse pulse power dissipation in avalanche region versus duration
P_{RSM} (kW)
10
5
2
1
0.5
0.2
0.1
0.01
0.1
1
10
duration (ms)
100
P_R
P_{RSM}
time
pulse duration
T_j = 25°C
75°C
125°C
150°C
175°C
7Z05723 - 2.25.24.be


300
I_F (A)
200
100
0
0
1
2
3
4
V_F (V)
5
typ
T_j = 25°C
175°C
7Z05726 - 2.25.24.be


Max. permissible non repetitive peak forward current based on sinusoidal currents (f=50Hz)
I_F
I_{FSM}
time
I_{FSM}
(A)
400
300
200
100
0
1
2
3
4
5
6
7
8
9
20
50
100
number of cycles
$T_j = 175°C$
7Z05725


Max. allowable non repetitive r.m.s. forward current (sub cycle surge curve)
$I_{FS(RMS)}$
(A)
800
600
400
200
0
0
2
4
6
8
10
12
duration (ms)
$T_j = 175°C$
7Z05724.1

CONTROLLED AVALANCHE RECTIFIER DIODES

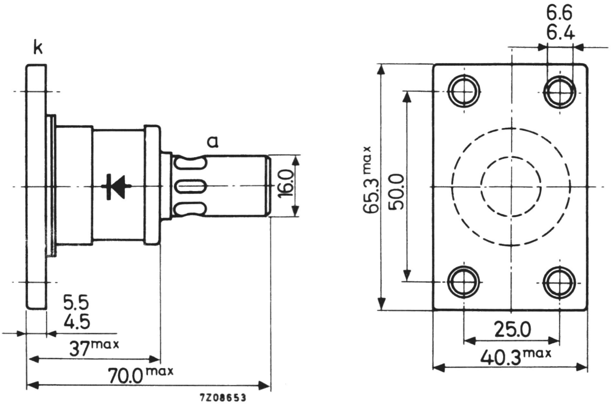
Diffused silicon diodes in metal envelopes with ceramic insulation, capable of absorbing transients and intended for power rectifier application.
The series consists of normal polarity types: BYX27-400 to 1000.

QUICK REFERENCE DATA

		BYX27 -	400	600	800	1000	
Crest working reverse voltage	V_{RWM} max.		400	600	800	1000	V
Reverse avalanche breakdown voltage	$V_{(BR)R}$	>	500	750	1000	1250	V
		<	1600	1600	1600	1600	V
Average forward current up to T_{mb} = 125 °C	$I_{F(AV)}$	max.	250				A
Non-repetitive peak forward current t = 10 ms; T_j = 190 °C prior to surge	I_{FSM}	max.	4000				A
Non-repetitive peak reverse power dissipation (t = 10 µs; T_j = 25 °C)	P_{RSM}	max.	80				kW
Operating junction temperature	T_j	max.	190				°C

MECHANICAL DATA

Dimensions in mm



Net weight: 230 g
Accessories and mounting instructions: see page 3.

All information applies to frequencies up to 400 Hz.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages 1)			BYX27 – 400	600	800	1000	
Continuous reverse voltage	V_R	max.	400	600	800	1000	V
Crest working reverse voltage	V_{RWM}	max.	400	600	800	1000	V

Currents

Average forward current (averaged over any 20 ms period) up to $T_{mb} = 125\,^{\circ}C$	$I_{F(AV)}$	max.	250	A
Forward current (d. c.)	I_F	max.	400	A
R. M. S. forward current	$I_{F(RMS)}$	max.	400	A
Repetitive peak forward current	I_{FRM}	max.	1250	A
Non-repetitive peak forward current (t = 10 ms; half sine wave) $T_j = 190\,^{\circ}C$ prior to surge	I_{FSM}	max.	4000	A
I squared t for fusing (t = 10 ms)	I^2t	max.	80000	A^2s

Reverse power dissipation

Average reverse power dissipation (averaged over any 20 ms period) $T_j = 190\,^{\circ}C$	$P_{R(AV)}$	max.	80	W
Repetitive peak reverse power dissipation t = 10 µs (square wave; f = 50 Hz) $T_j = 190\,^{\circ}C$	P_{RRM}	max.	20	kW
Non-repetitive peak reverse power dissipation; t = 10 µs (square wave) $T_j = 25\,^{\circ}C$ prior to surge	P_{RSM}	max.	80	kW
$T_j = 190\,^{\circ}C$ prior to surge	P_{RSM}	max.	40	kW

Temperatures

Storage temperature	T_{stg}		–55 to +200	°C
Operating junction temperature	T_j	max.	190	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	0. 2	°C/W
From mounting base to heatsink				
without heatsink compound	$R_{th\ mb\text{-}h}$	=	0. 07	°C/W
with heatsink compound (e. g. Dow corning 340)	$R_{th\ mb\text{-}h}$	=	0. 03	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0. 02	°C/W

---

1) To ensure thermal stability $R_{th\ j\text{-}a} \leq 0.7$ °C/W (continuous reverse voltage) or ≤ 1.3 °C/W (a. c.)

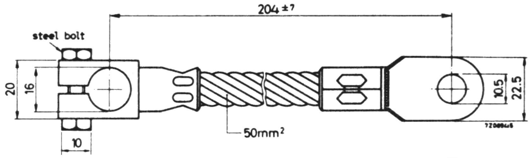
CHARACTERISTICS

			BYX27-400	600	800	1000	
Forward voltage I_F = 1250 A; T_j = 25 °C	V_F	$<$	1.7	1.7	1.7	1.7	V[1]
Reverse avalanche breakdown voltage I_R = 25 mA; T_j = 25 °C	$V_{(BR)R}$	$>$	500	750	1000	1250	V
		$<$	1600	1600	1600	1600	V
Peak reverse current $V_{RM} = V_{RWMmax}$; T_j = 175 °C	I_{RM}	$<$	50	42	32	25	mA

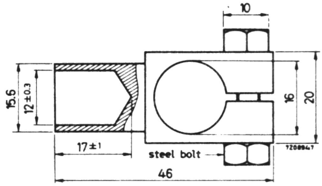
ACCESSORIES AND MOUNTING INSTRUCTIONS

Dimensions in mm

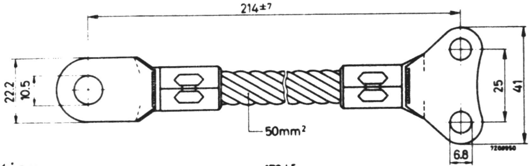
Flexible top lead
Type number 56243
Weight: 170 g


204±7
steel bolt
20
16
10
50mm²
10.5
22.5

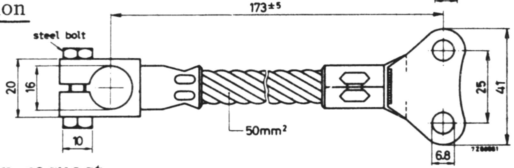
Clamp
Type number 56244
Weight: 70 g


10
15.6
12±0.3
16
20
17±1
steel bolt
46

Flexible base lead
Type number 56247
Weight: 135 g


214±7
22.2
10.5
50mm²
25
41
6.8

Flexible top lead for series connection
Type number 56296
Weight: 155 g


173±5
steel bolt
20
16
10
50mm²
25
41
6.8

1. These accessories are supplied on request.
2. For mounting of the flexible top lead it is recommended to use two spanners to avoid damage.
   Torque on nut: min. 30 kg cm (3 Newton-metres); max. 60 kg cm (6 Newton-metres)
3. For mounting the diode on a heatsink use steel bolts.
   Min. torque for good thermal and electrical contact: 30 kgcm (3 Newton-metres)
   Max. torque : 60 kgcm (6 Newton-metres)

---

[1] Measured under pulsed conditions to avoid excessive dissipation.

OPERATING NOTES (See also general pages at the beginning of this section)

1. Voltage sharing of series connected controlled avalanche diodes.

   When diodes with avalanche characteristics are connected in series, the usual R and C elements for voltage sharing can be omitted.

2. Switching transients for controlled avalanche diodes.

   In an unloaded rectifier circuit, when the transformer is switched off, energy is released.
   When, as a result, no diode rating is exceeded, special provisions are not needed. If, however, the rated non repetitive peak power dissipation per device could be exceeded, damping across the transformer is necessary in order to protect the device.

   The duration of the transformer's energy release can be found in first approximation from the empirical formula:

$$t = \frac{V_{RWM}}{V_{(BR)R\,min}}\text{; (milliseconds)}$$

where V_{RWM} = actually applied crest working voltage

$V_{(BR)R\,min}$ = minimum reverse breakdown voltage

The non-repetitive peak power that can be absorbed by a single device during t ms can be derived from the graph on page 5. Multiplying that amount with the time in which it is released results in the energy absorbed by one diode. (E_D).
A series string of n diodes can absorb n times as much. ($n.E_D$)

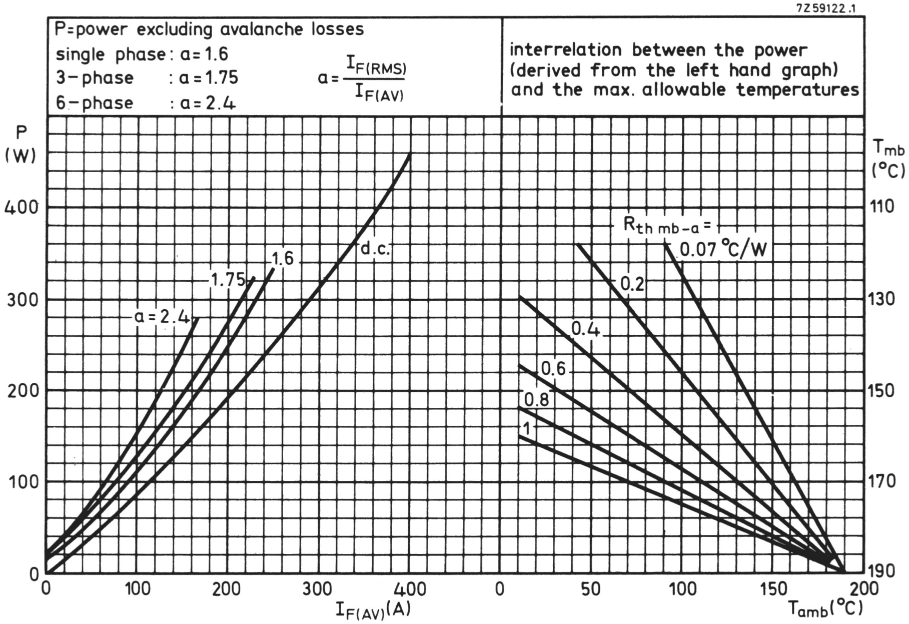
The difference between the energy released by the transformer and that absorbed by the n diodes should be absorbed by series connected R and C elements across the secondary winding of the transformer.
The magnitudes of R and C have to be derived from the following formulae:

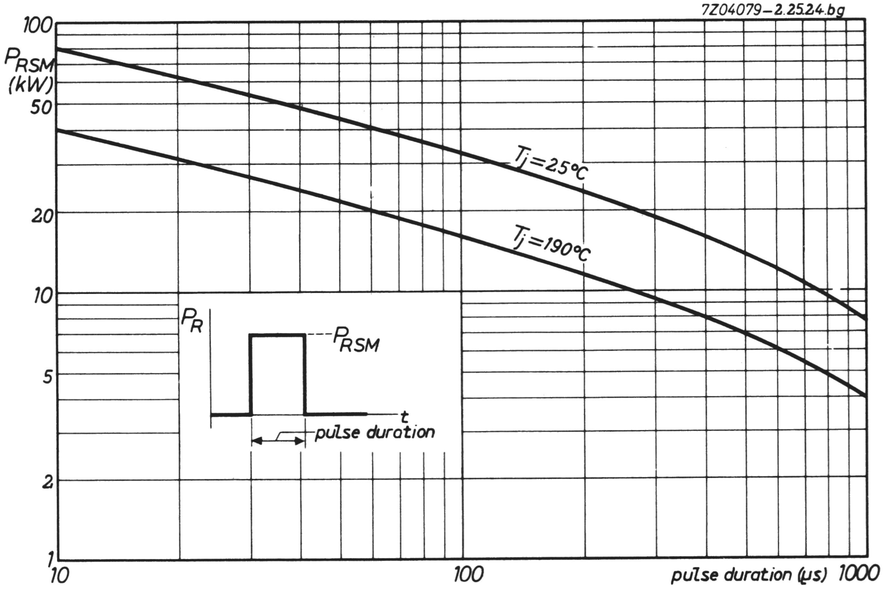
$$C = \frac{E_T - n.E_D}{(n.V_{(BR)R\,min})^2} \cdot 10^6 \quad (\mu F) \qquad R = \frac{310}{C} \quad (\Omega)$$

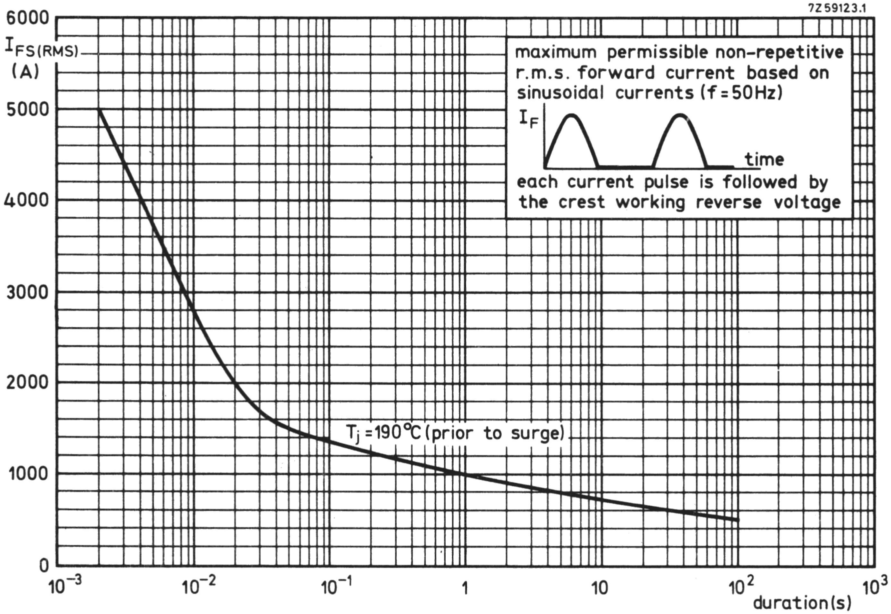
where C = capacitance in μF
E_T = energy released by the transformer in Ws
n = number of diodes in series
E_D = energy absorbed by one diode in Ws
$V_{(BR)R\,min}$ = minimum reverse breakdown voltage of one diode in V
R = resistance in Ω

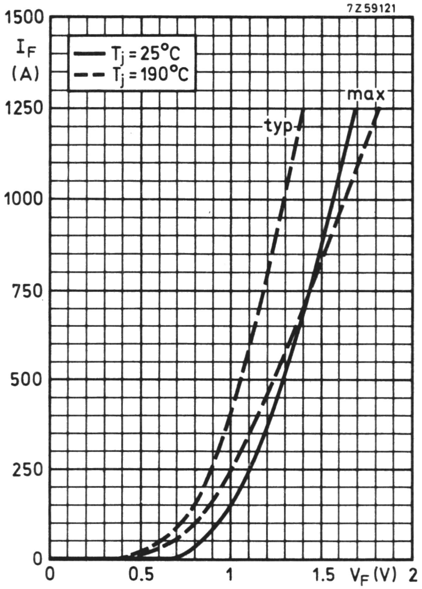
APPLICATION INFORMATION

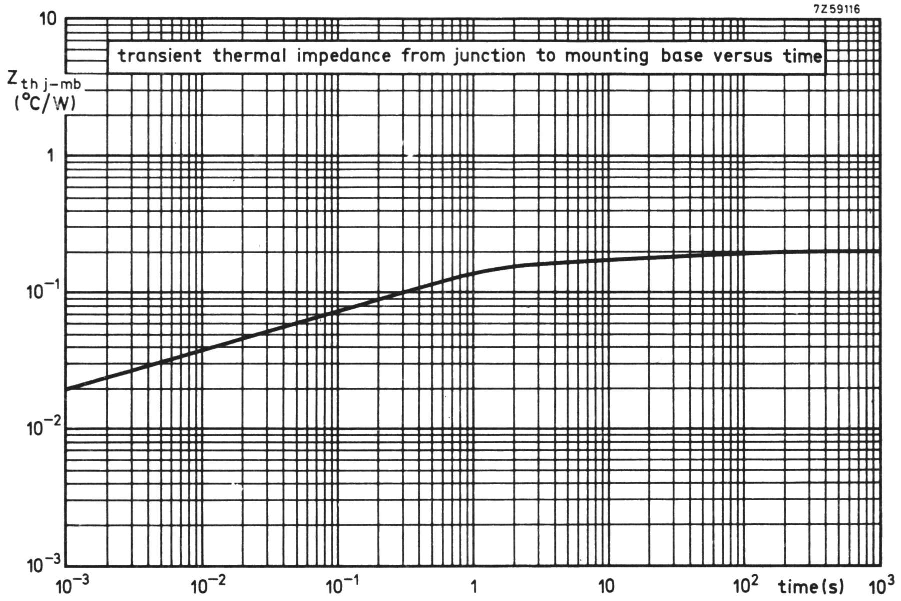
See general pages at the beginning of this section.


7Z59122.1
P=power excluding avalanche losses
single phase : a = 1.6
3-phase : a = 1.75
6-phase : a = 2.4
a = I_F(RMS) / I_F(AV)
interrelation between the power (derived from the left hand graph) and the max. allowable temperatures
P (W)
400
300
200
100
0
a = 2.4
1.75
1.6
d.c.
0
100
200
300
400
I_F(AV) (A)
0
50
100
150
200
T_amb (°C)
R_th mb-a =
0.07 °C/W
0.2
0.4
0.6
0.8
1
T_mb (°C)
110
130
150
170
190


7Z04079-2.25.24.bg
P_RSM (kW)
100
50
20
10
5
2
1
10
100
1000
pulse duration (μs)
T_j = 25 °C
T_j = 190 °C
P_R
P_RSM
t
pulse duration


7Z59123.1
$I_{FS(RMS)}$
(A)
6000
5000
4000
3000
2000
1000
0
10^{-3}
10^{-2}
10^{-1}
1
10
10^{2}
10^{3}
duration(s)
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50Hz)
I_F
time
each current pulse is followed by the crest working reverse voltage
T_j = 190°C (prior to surge)


7Z59121
I_F
(A)
1500
1250
1000
750
500
250
0
0
0.5
1
1.5
V_F (V)
2
T_j = 25°C
T_j = 190°C
typ
max


7Z59116
transient thermal impedance from junction to mounting base versus time
$Z_{th\ j-mb}$ (°C/W)
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-3}
10^{-2}
10^{-1}
1
10
10^{2}
time (s)
10^{3}

CONTROLLED AVALANCHE HIGH VOLTAGE DIODES

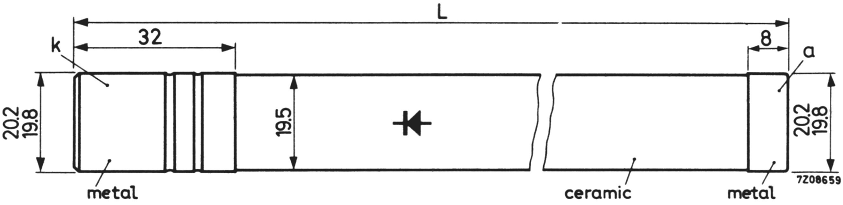
Silicon diodes in a ceramic envelope with metal connectors capable of absorbing transients and primarily intended for high voltage rectifier circuits in X-ray applications.
The series consists of the following types:
BYX29-75000, BYX29-100000, BYX29-125000 and BYX29-150000.

QUICK REFERENCE DATA

			BYX29-75000	100000	125000	150000
Crest working reverse voltage	V_{RWM}	max.	75	100	125	150 kV
Average forward current	I_{FAV}	max.	50	50	50	50 mA
Non repetitive peak forward current; t = 10 ms	I_{FSM}	max.	5000	5000	5000	5000 mA
Junction temperature	T_j	max.	125	125	125	125 °C
Thermal resistance from junction to cooling oil	$R_{th\ j\text{-}o}$	=	3.2	2.7	1.6	1.6 °C/W

MECHANICAL DATA

Dimensions in mm



BYX29- 75000	L : 141 to 143 mm	Weight: 135 g
BYX29-100000	L : 169 to 171 mm	Weight: 165 g
BYX29-125000	L : 229 to 231 mm	Weight: 225 g
BYX29-150000	L : 229 to 231 mm	Weight: 225 g

All information applies to frequencies up to 400 Hz

RATINGS (Limiting values) [1]

Voltages			BYX29-75000	100000	125000	150000	
Crest working reverse voltage	V_{RWM}	max.	75	100	125	150	kV

Currents

Average forward current (averaged over any 20 ms period)				
continuous operation	I_{FAV}	max.	50	mA
intermittent operation ($t \leq 1$ s, once every 20 s)	I_{FAV}	max.	750	mA
Repetitive peak forward current				
continuous operation	I_{FRM}	max.	250	mA
intermittent operation (at an average forward current I_{FAV} = 750 mA; $t \leq 1$ s, once every 20 s)	I_{FRM}	max.	2500	mA
Non repetitive peak forward current (t = 10 ms)	I_{FSM}	max.	5000	mA
Non repetitive peak reverse current				
$t < 10\ \mu s$; T_j = 25 °C	I_{RSM}	max.	500	mA
T_j = 125 °C	I_{RSM}	max.	400	mA

Temperatures

Storage temperature	T_{stg}		−30 to +125	°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

		BYX29-75000	100000	125000	150000	
From junction to cooling oil	$R_{th\ j-o}$ =	3.2	2.7	1.6	1.6	°C/W

CHARACTERISTICS

Voltages at T_j = 25 °C						
Forward voltage at I_F = 50 mA	V_F <	88	116	145	175	V
Reverse breakdown voltage						
I_R = 1 mA	$V_{(BR)R}$ >	100	135	165	200	kV
Currents at T_j = 125 °C						
Reverse current at $V_R = V_{RWMmax}$	I_R <	33	33	33	33	μA

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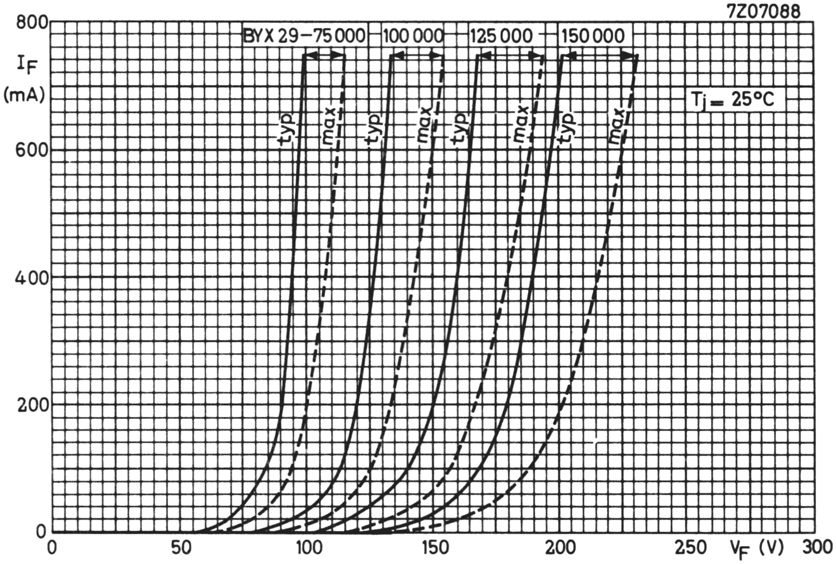
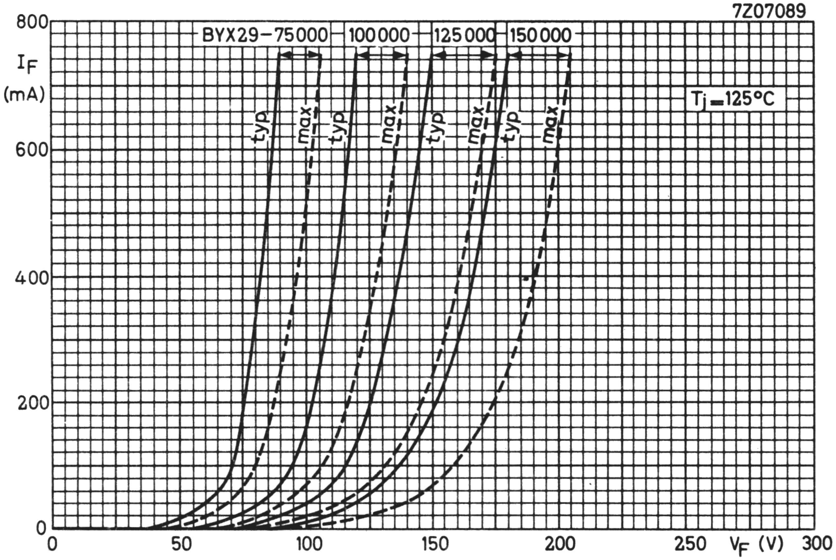
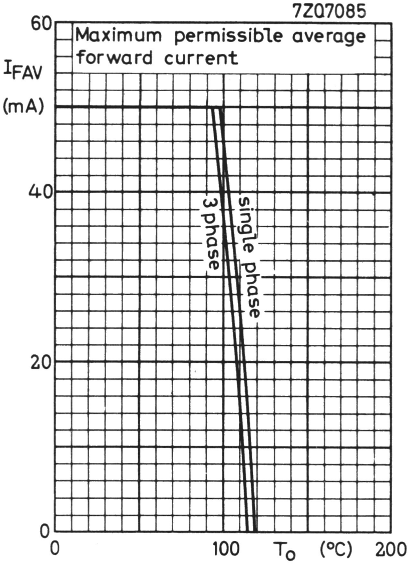
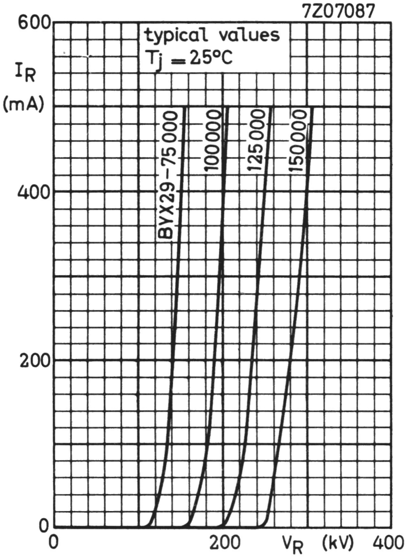
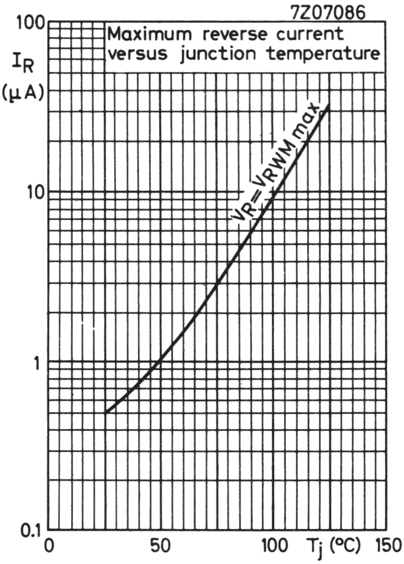
[1] Limiting values according to the Absolute Maximum System as defined in IEC publication 134.


7Z07088
800
600
400
200
0
I_F
(mA)
BYX 29–75 000
100 000
125 000
150 000
typ
max
Tj = 25 °C
0
50
100
150
200
250
300
V_F (V)


7Z07089
800
600
400
200
0
I_F
(mA)
BYX29–75000
100000
125000
150000
typ
max
Tj = 125 °C
0
50
100
150
200
250
300
V_F (V)


7Z07085
Maximum permissible average forward current
I_{FAV}
(mA)
60
40
20
0
3 phase
single phase
0
100
T_o (°C)
200


7Z07087
typical values
$T_j = 25°C$
I_R
(mA)
600
400
200
0
BYX29–75000
100000
125000
150000
0
200
V_R (kV)
400


7Z07086
Maximum reverse current versus junction temperature
I_R
(μA)
100
10
1
0.1
$V_R = V_{RWM}$ max
0
50
100
T_j (°C)
150

FAST RECOVERY RECTIFIER DIODES WITH CONTROLLED AVALANCHE

Diffused silicon diodes in a DO-4 metal envelope, capable of absorbing transients. They are primarily intended for use in high frequency power supplies, thyristor inverters and multi-phase power rectifier applications.
The series consists of the following types:
Normal polarity (cathode to stud): BYX30-200 to BYX30-600.
Reverse polarity (anode to stud) : BYX30-200R to BYX30-600R.

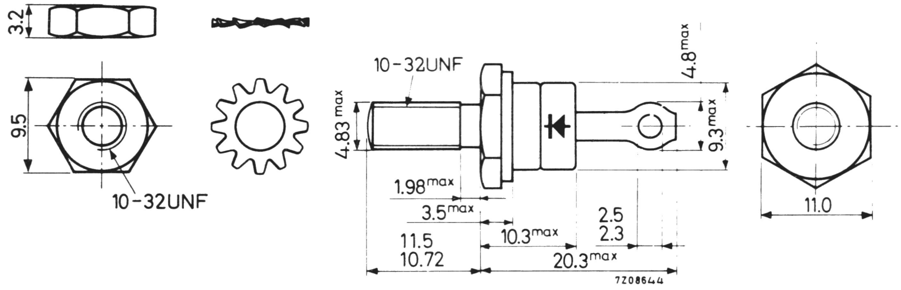
QUICK REFERENCE DATA

		BYX30-200(R)	300(R)	400(R)	500(R)	600(R)	
Crest working reverse voltage	V_{RWM} max.	200	300	400	500	600	V
Reverse avalanche breakdown voltage	$V_{(BR)R}$ >	250	375	500	625	750	V

Average forward current at T_{mb} = 100 °C	$I_{F(AV)}$	max.	14	A
T_{mb} = 125 °C	$I_{F(AV)}$	max.	7.5	A
Non-repetitive peak forward current t = 10 ms; T_j = 150 °C prior to surge	I_{FSM}	max.	250	A
Junction temperature	T_j	max.	150	°C
Reverse recovery time when switched from I_F = 2 A to V_R = 30 V $-dI/dt$ = 100 A/μs	t_{rr}	<	0.35	μs

MECHANICAL DATA

Dimensions in mm



The mark shown applies to normal polarity types
Net weight: 7.6 g
Diameter of clearance hole: max. 5.2 mm
Accessories supplied on request: 56295, (56262A)

Torque on nut: min. 8 kg cm
(0.8 Newton-metres)
max. 17 kg cm
(1.7 Newton-metres)

All information applies to frequencies up to 50 kHz

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages [1]			BYX30-200(R)	300(R)	400(R)	500(R)	600(R)	
Continuous reverse voltage	V_R	max.	200	300	400	500	600	V
Crest working reverse voltage	V_{RWM}	max.	200	300	400	500	600	V

Currents				
Average forward current (averaged over any 20 ms period) up to T_{mb} = 100 °C	$I_{F(AV)}$	max.	14	A
at T_{mb} = 125 °C	$I_{F(AV)}$	max.	7.5	A
Forward current (d.c.)	I_F	max.	17	A
Repetitive peak forward current	I_{FRM}	max.	310	A
Non-repetitive peak forward current (t = 10 ms; half sine wave) T_j = 150 °C prior to surge	I_{FSM}	max.	250	A
Repetitive peak reverse current (during turn-off)	I_{RRM}	max.	20	A

Reverse power dissipation				
Repetitive peak reverse power dissipation t = 10 μs (square wave; f = 50 Hz) T_j = 150 °C	P_{RRM}	max.	5.5	kW
Non-repetitive peak reverse power dissipation t = 10 μs (square wave) T_j = 25 °C prior to surge	P_{RSM}	max.	18	kW
T_j = 150 °C prior to surge	P_{RSM}	max.	5.5	kW

Temperatures				
Storage temperature	T_{stg}		−55 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	50	°C/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.3	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.5	°C/W

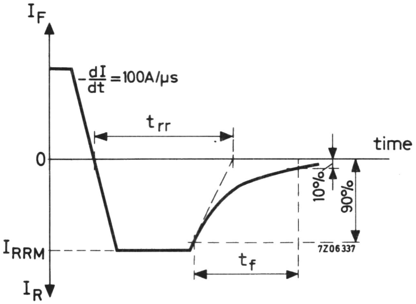
---

[1] To ensure thermal stability: $R_{th\ j\text{-}a} < 2.5$ °C/W (continuous reverse voltage) or < 5 °C/W (a.c.).
For smaller heatsinks $T_{j\ max}$ should be derated. For a.c. see page 5.
For continuous reverse voltage: if $R_{th\ j\text{-}a}$ = 5 °C/W, then $T_{j\ max}$ = 135 °C,
if $R_{th\ j\text{-}a}$ = 10 °C/W, then $T_{j\ max}$ = 120 °C.

CHARACTERISTICS

			BYX30-200(R)	300(R)	400(R)	500(R)	600(R)	
Forward voltage I_F = 50 A; T_j = 25 °C	V_F	<	3.2	3.2	3.2	3.2	3.2	V[1]
Reverse breakdown voltage I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	>	250	375	500	625	750	V
		<	1050	1050	1050	1050	1050	V
Peak reverse current $V_{RM} = V_{RWMmax}$; T_j = 125 °C	I_{RM}	<	4.0	4.0	4.0	4.0	4.0	mA

Reverse recovery charge when switched from I_F = 2 A to V_R = 30 V; with $-dI/dt$ = 100 A/µs; T_j = 25 °C	Q_s	<	0.70	µC
Reverse recovery time when switched from I_F = 2 A to V_R = 30 V; $-\frac{dI}{dt}$ = 100 A/µs; T_j = 150 °C	t_{rr}	<	0.35	µs
Fall time under all conditions	t_f	<	0.30	µs



OPERATING NOTES (See also general pages at the beginning of this section.)

1. Square wave operation
   When I_F has been flowing sufficiently long for the steady state to be established, there will be a charge due to minority carriers present. Before the device can block in the reverse direction this charge must be extracted. This extraction takes the form of a reverse transient (see figure above). The majority of the power dissipation due to the reverse transient occurs during t_f as the rectifier gradually becomes reverse biased, and the mean power will be proportional to the operating frequency. The mean value of this power loss can be derived from the graphs on page 10.

p.t.o.

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[1] Measured under pulsed conditions to avoid excessive dissipation.

OPERATING NOTES (continued)

2. Sine wave operation

Power loss in sine wave operation will be considerably less owing to the much slower rate of change of the applied voltage (and consequently lower values of I_{RRM}), so that power loss due to reverse recovery may be safely ignored for frequencies up to 20 kHz.

3. Determination of the heatsink thermal resistance

Example:
Assume a diode, used in an inverter.

frequency	f	=	20	kHz
duty cycle	δ	=	0.5	
ambient temperature	T_{amb}	=	45	°C
switched from	I_F	=	12	A
to	V_R	=	400	V
at a rate	$-\frac{dI}{dt}$	=	20	A/µs

At a duty cycle $\delta = 0.5$ the average forward current $I_{FAV} = 6$ A.
From the upper graph on page 5 it follows, that at $I_{FAV} = 6$ A the average forward power + average leakage power = 15 W (point A).
The additional power losses due to switching-off can be read from the nomogram on page 10 (the example being based on optimum use, i.e. $T_j = 150$ °C). Starting from $I_F = 12$ A on the horizontal scale trace upwards until the appropriate line $-\frac{dI}{dt} = 20$ A/µs. From the intersection trace horizontally to the right until the line for $f = 20$ kHz. Then trace downwards to the line $V_R = 400$ V and ultimately trace horizontally to the left and on the vertical axis read the additional average power dissipation $P_{RAV} = 4$ W.
Therefore the total power dissipation $P_{tot} = 15\ \text{W} + 4\ \text{W} = 19$ W (point B of the upper graph on page 5). From the right hand part follows the thermal resistance, required at $T_{amb} = 45$ °C.

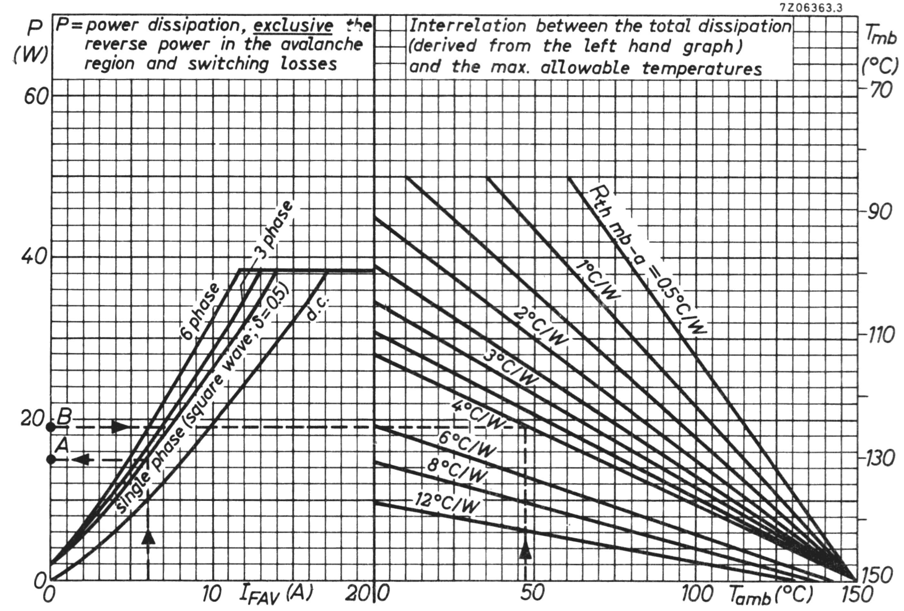
$$R_{th\ mb\text{-}a} \approx 4\ ^{\circ}\text{C/W}$$

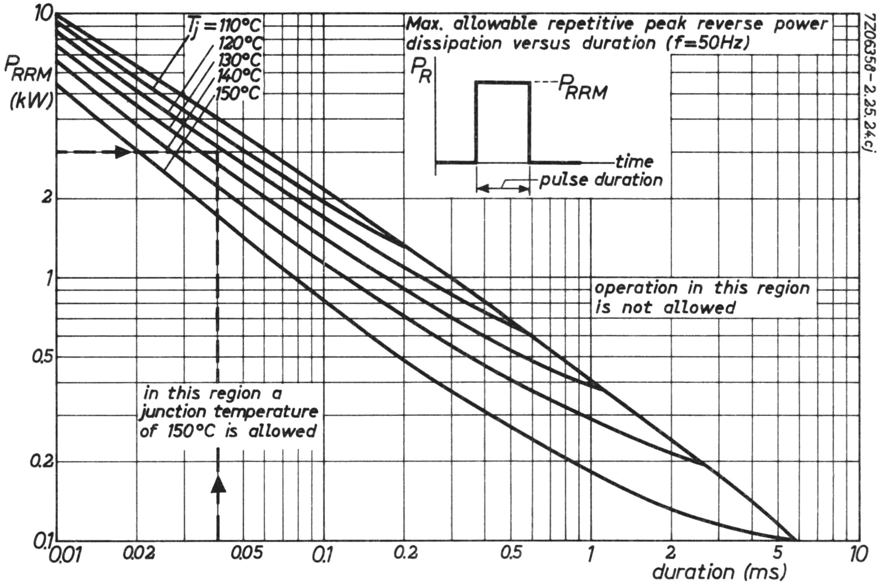
The contact thermal resistance $R_{th\ mb\text{-}h} = 0.5$ °C/W.

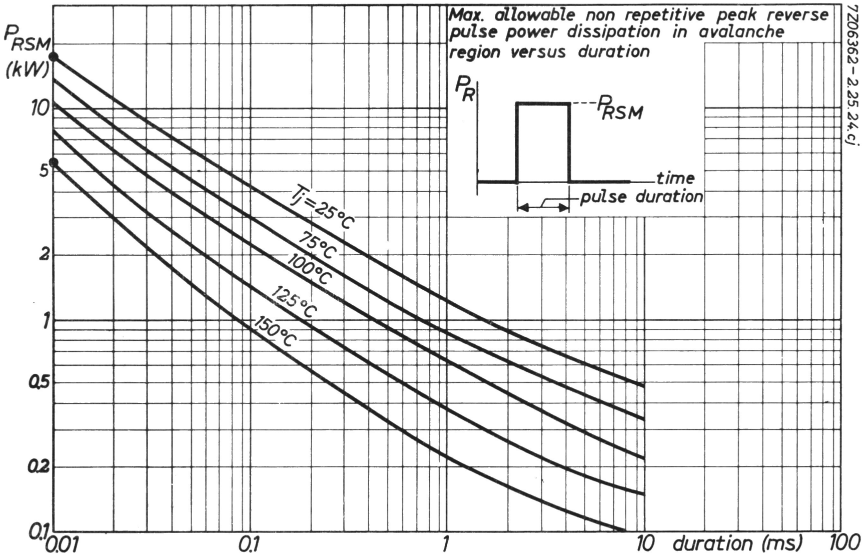
Hence the heatsink thermal resistance should be:

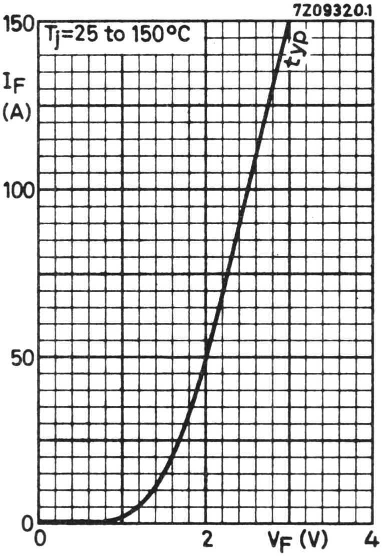
$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h} = (4 - 0.5)\ ^{\circ}\text{C/W} = 3.5\ ^{\circ}\text{C/W}.$$

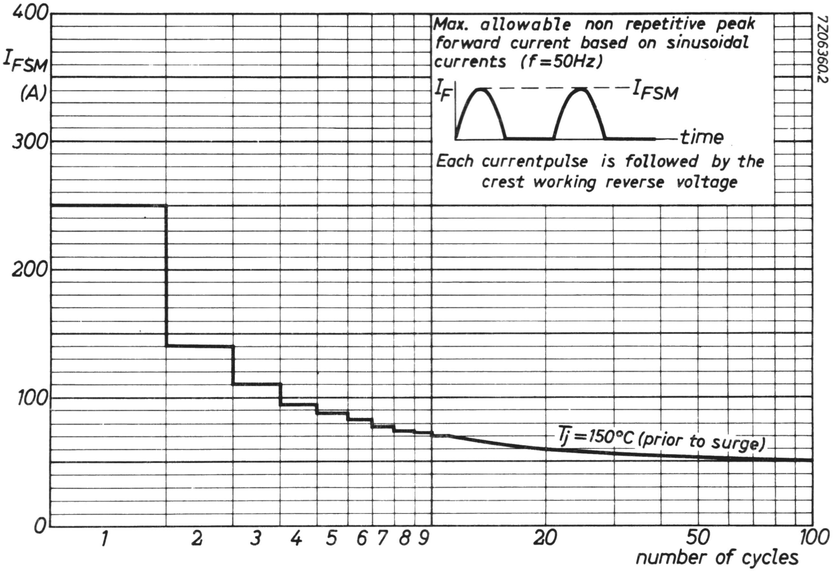
The applicable heatsink(s) may then be found in the Section HEATSINKS.


7Z06363.3
P
(W)
P = power dissipation, exclusive the reverse power in the avalanche region and switching losses
Interrelation between the total dissipation (derived from the left hand graph) and the max. allowable temperatures
T_{mb}
(°C)
60
40
20
0
B
A
6 phase
3 phase
single phase (square wave; δ=0.5)
d.c.
$R_{th\ mb-a}$ = 0.5°C/W
1°C/W
2°C/W
3°C/W
4°C/W
6°C/W
8°C/W
12°C/W
70
90
110
130
150
0
10
I_{FAV} (A)
20
0
50
100
T_{amb} (°C)
150

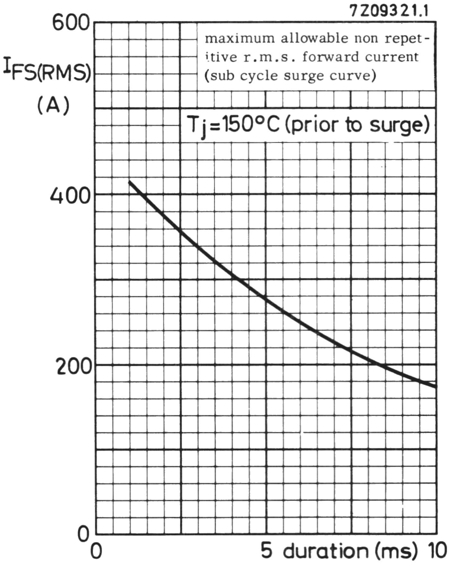

10
P_{RRM}
(kW)
2
1
0.5
0.2
0.1
T_j = 110°C
120°C
130°C
140°C
150°C
Max. allowable repetitive peak reverse power dissipation versus duration (f=50Hz)
P_R
P_{RRM}
time
pulse duration
7Z06358-2.25.24.cj
operation in this region is not allowed
in this region a junction temperature of 150°C is allowed
0.01
0.02
0.05
0.1
0.2
0.5
1
2
5
10
duration (ms)


Max. allowable non repetitive peak reverse pulse power dissipation in avalanche region versus duration
7Z06362-2.25.24.cj
P_{RSM} (kW)
10
5
2
1
0.5
0.2
0.1
0.01
0.1
1
10
duration (ms)
100
T_j=25°C
75°C
100°C
125°C
150°C
P_R
P_{RSM}
time
pulse duration

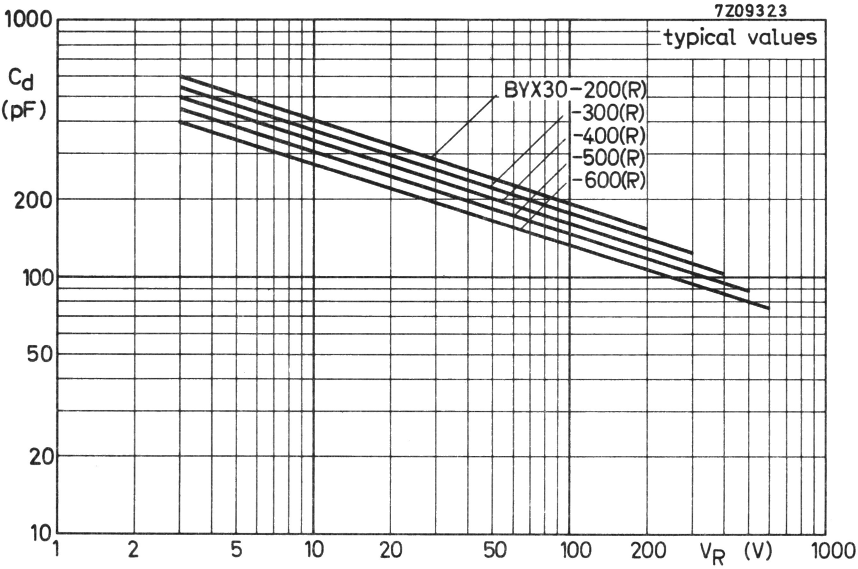

7Z09320.1
T_j=25 to 150°C
typ
I_F (A)
150
100
50
0
0
2
V_F (V)
4

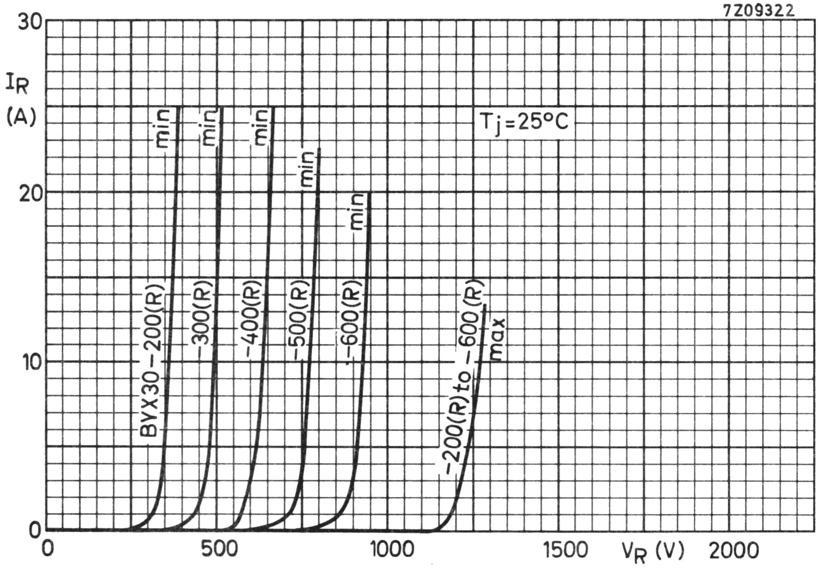


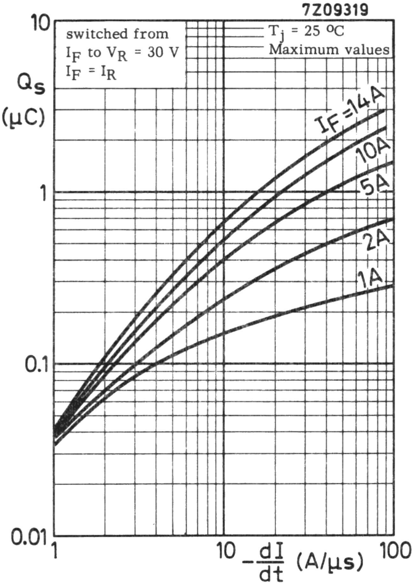
400
300
200
100
0
I_{FSM} (A)
Max. allowable non repetitive peak forward current based on sinusoidal currents (f = 50Hz)
I_F
I_{FSM}
time
Each currentpulse is followed by the crest working reverse voltage
7Z06360.2
T_j = 150°C (prior to surge)
1
2
3
4
5
6
7
8
9
20
50
100
number of cycles

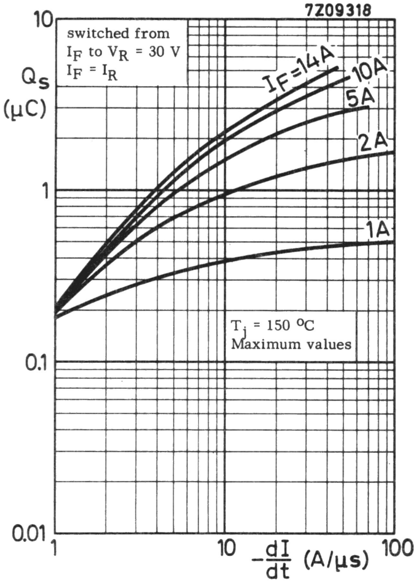


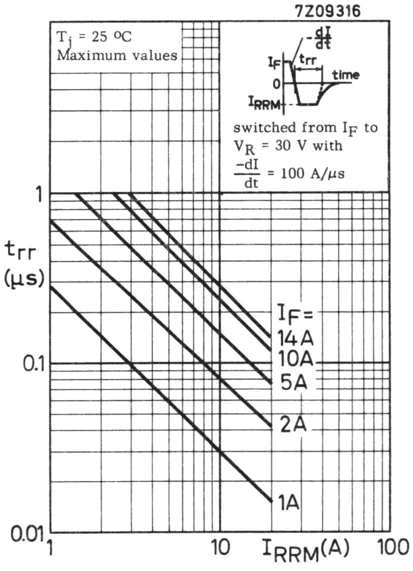
7Z09321.1
600
400
200
0
$I_{FS(RMS)}$ (A)
maximum allowable non repetitive r.m.s. forward current (sub cycle surge curve)
T_j = 150°C (prior to surge)
0
5
10
duration (ms)

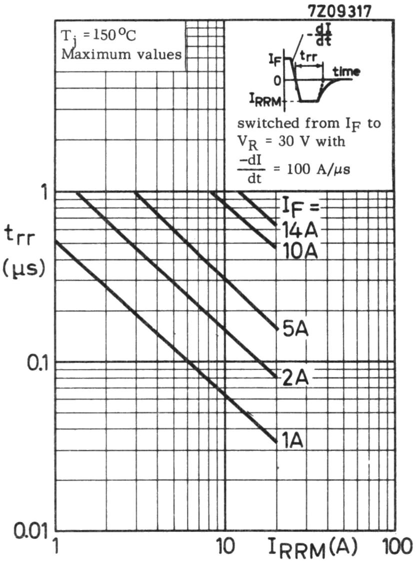

7Z09323
typical values
C_d (pF)
1000
200
100
50
20
10
1
2
5
10
20
50
100
200
V_R (V)
1000
BYX30−200(R)
−300(R)
−400(R)
−500(R)
−600(R)

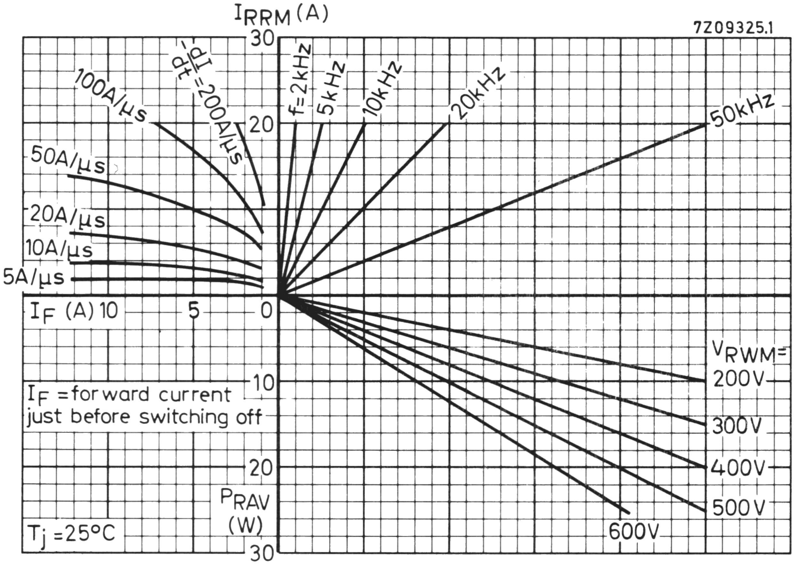

7Z09322
I_R (A)
30
20
10
0
500
1000
1500
V_R (V)
2000
T_j=25°C
min
min
min
min
min
BYX30−200(R)
−300(R)
−400(R)
−500(R)
−600(R)
−200(R) to −600(R)
max

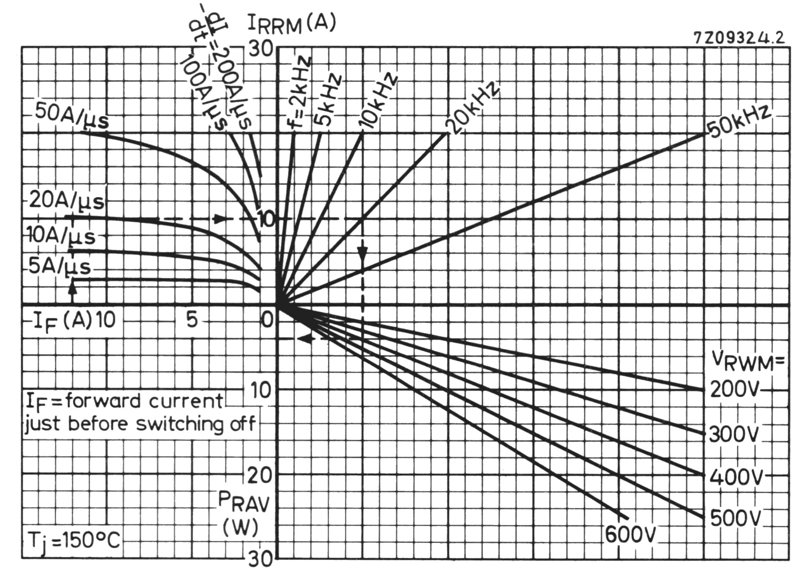

7Z09319
switched from
I_F to V_R = 30 V
$I_F = I_R$
T_j = 25 °C
Maximum values
Q_s (μC)
I_F=14A
10A
5A
2A
1A
10
1
0.1
0.01
1
10
100
$-\frac{dI}{dt}$ (A/μs)


7Z09318
switched from
I_F to V_R = 30 V
$I_F = I_R$
Q_s (μC)
I_F=14A
10A
5A
2A
1A
T_j = 150 °C
Maximum values
10
1
0.1
0.01
1
10
100
$-\frac{dI}{dt}$ (A/μs)


7Z09316
T_j = 25 °C
Maximum values
$-\frac{dI}{dt}$
I_F
t_{rr}
0
time
I_{RRM}
switched from I_F to V_R = 30 V with $\frac{-dI}{dt}$ = 100 A/μs
t_{rr} (μs)
I_F =
14A
10A
5A
2A
1A
1
0.1
0.01
1
10
100
I_{RRM}(A)


7Z09317
T_j = 150 °C
Maximum values
$-\frac{dI}{dt}$
I_F
t_{rr}
0
time
I_{RRM}
switched from I_F to V_R = 30 V with $\frac{-dI}{dt}$ = 100 A/μs
t_{rr} (μs)
I_F =
14A
10A
5A
2A
1A
1
0.1
0.01
1
10
100
I_{RRM}(A)





Nomogram: Power loss P_{RAV} due to switching only (square wave operation)

SILICON RECTIFIER DIODES

Diffused silicon diodes in metal envelopes with ceramic insulation, intended for power rectifier application. The series consists of the following types:
Normal polarity (cathode to stud): BYX32-400 to BYX32-1600
Reverse polarity (anode to stud): BYX32-400R to BYX32-1600R

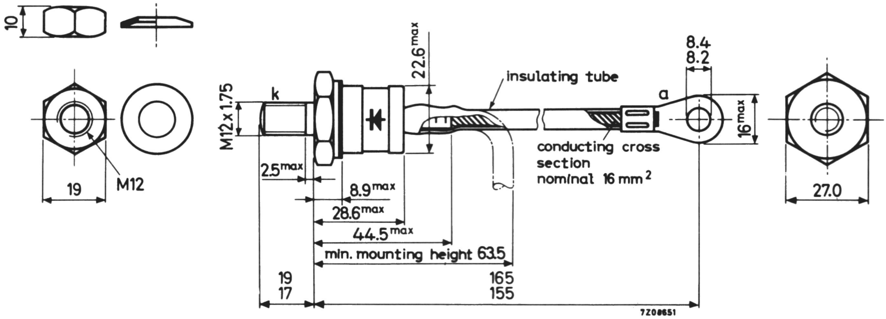
QUICK REFERENCE DATA

		BYX32-	400 400R	600 600R	800 800R	1000 1000R	1200 1200R	1600 1600R	
Crest working reverse voltage	V_{RWM}	max.	400	600	800	1000	1200	1200	V
Repetitive peak reverse voltage	V_{RRM}	max.	400	600	800	1000	1200	1600	V

Average forward current up to T_{mb} = 100 °C	$I_{F(AV)}$	max.	150	A
at T_{mb} = 125 °C	$I_{F(AV)}$	max.	115	A
Non-repetitive peak forward current t = 10 ms; T_j = 190 °C prior to surge	I_{FSM}	max.	1600	A
Operating junction temperature	T_j	max.	190	°C

MECHANICAL DATA

Dimensions in mm


10
19
M12
M12x1.75
k
22.6max
insulating tube
a
8.4
8.2
16max
conducting cross section nominal 16 mm²
27.0
2.5max
8.9max
28.6max
44.5max
min. mounting height 63.5
19
17
165
155
7Z08651

Normal polarity (-|◀-): blue cable. Reverse polarity (-▶|-): red cable.

Net weight : 115 g

Diameter of clearance hole: max. 13.0 mm

Torque on nut: min. 100 kg cm
(10 Newton-metres)
max. 250 kg cm
(25 Newton-metres)

All information applies to frequencies up to 400 Hz.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages 1)		BYX32-	400 400R	600 600R	800 800R	1000 1000R	1200 1200R	1600 1600R	
Continuous reverse voltage	V_R	max.	400	600	800	1000	1200	1200	V
Crest working reverse voltage	V_{RWM}	max.	400	600	800	1000	1200	1200	V
Repetitive peak reverse voltage	V_{RRM}	max.	400	600	800	1000	1200	1600	V
Non-repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	450	650	900	1100	1300	1600	V

Currents

Average forward current (averaged over any 20 ms period) up to $T_{mb} = 100\ ^{o}C$	$I_{F(AV)}$	max.	150 A
at $T_{mb} = 125\ ^{o}C$	$I_{F(AV)}$	max.	115 A
Forward current (d. c.)	I_F	max.	240 A
R. M. S. forward current	$I_{F(RMS)}$	max.	240 A
Repetitive peak forward current	I_{FRM}	max.	750 A
Non-repetitive peak forward current ($t = 10$ ms; half sine wave) $T_j = 190\ ^{o}C$ prior to surge	I_{FSM}	max.	1600 A
I squared t for fusing ($t = 10$ ms)	I^2t	max.	12800 A^2s

Temperatures

Storage temperature	T_{stg}		-55 to +200 °C
Operating junction temperature	T_j	max.	190 °C

THERMAL RESISTANCE

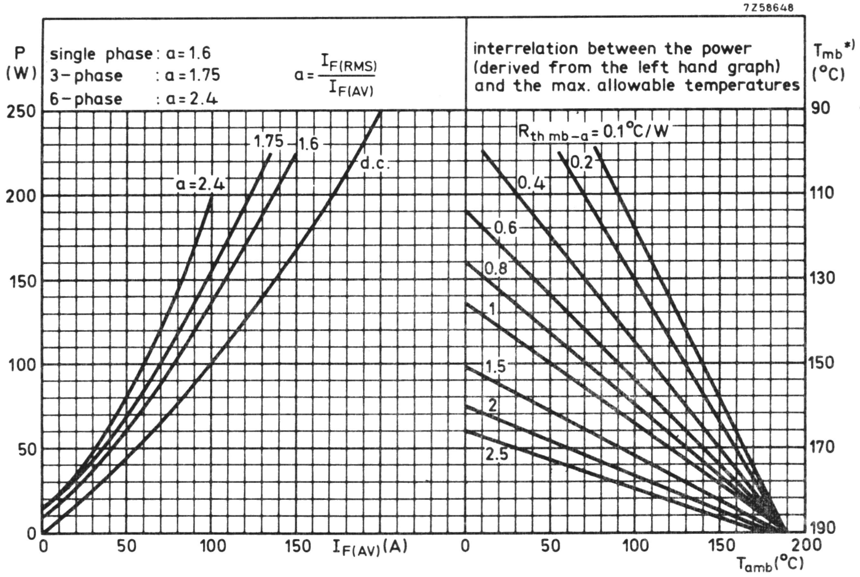
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	0.4 °C/W
From mounting base to heatsink without heatsink compound	$R_{th\ mb\text{-}h}$	=	0.1 °C/W
From mounting base to heatsink with heatsink compound (Dow Corning 340)	$R_{th\ mb\text{-}h}$	=	0.04 °C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.025 °C/W

---

1) To ensure thermal stability: $R_{th\ j\text{-}a} < 0.75\ ^{o}C/W$ (continuous reverse voltage) or $< 1.5\ ^{o}C/W$ (a. c.)
For smaller heatsinks T_j should be derated. For a. c. see graph on page 3.
For continuous reverse voltage: $R_{th\ j\text{-}a} = 1\ ^{o}C/W$, then $T_{jmax} = 184\ ^{o}C$
$R_{th\ j\text{-}a} = 1.2\ ^{o}C/W$, then $T_{jmax} = 180\ ^{o}C$
$R_{th\ j\text{-}a} = 1.5\ ^{o}C/W$, then $T_{jmax} = 175\ ^{o}C$

CHARACTERISTICS

		BYX32 – 400(R)	600(R)	800(R)	1000(R)	1200(R)	1600(R)	
Forward voltage $I_F = 500\,A; T_j = 25\,^{\circ}C$	$V_F <$	1.6	1.6	1.6	1.6	1.6	1.6	V[1] ←
Peak reverse current $V_{RM} = V_{RWM\,max}$ $T_j = 175\,^{\circ}C$	$I_{RM} <$	30	24	18	15	12	12	mA ←



*) T_{mb}-scale is for comparison purposes only and is correct only for $R_{th\,mb-a} \leq 1.1\,^{\circ}C/W$

APPLICATION INFORMATION AND OPERATING NOTES

See general pages at the beginning of this section.

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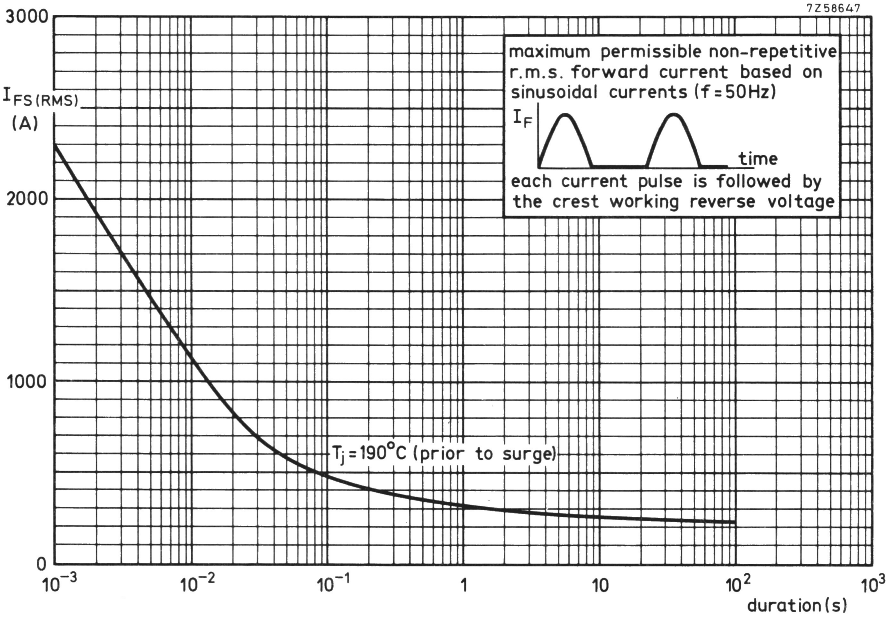
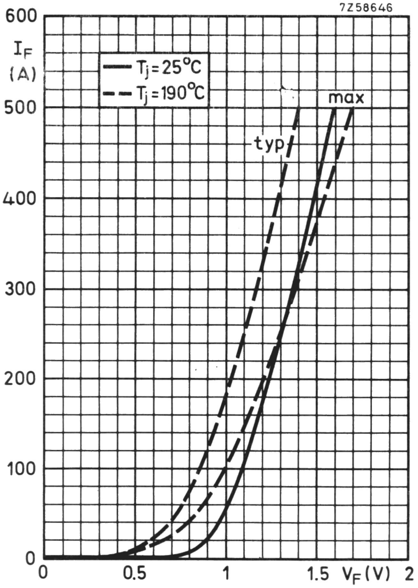
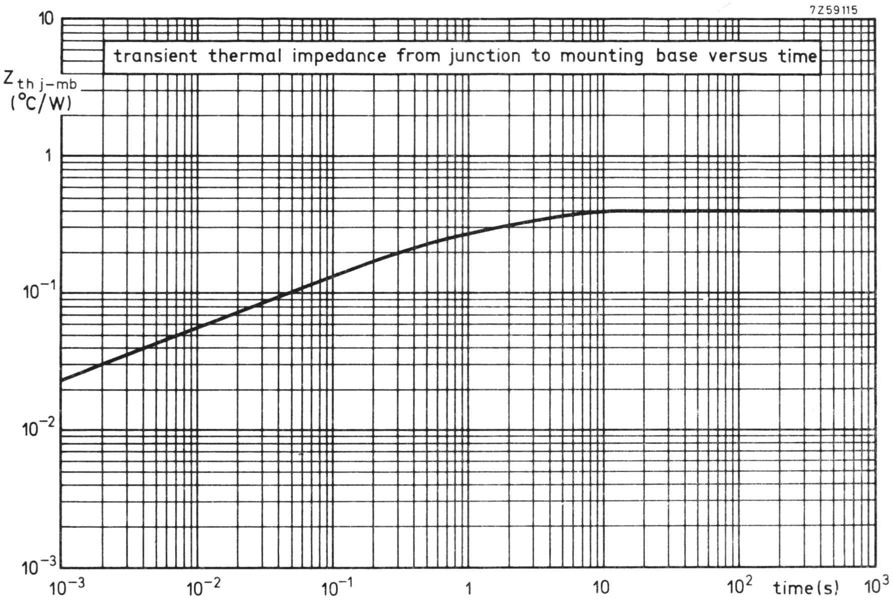
[1] Measured under pulsed conditions to avoid excessive dissipation.


7Z58647
3000
$I_{FS(RMS)}$
(A)
2000
1000
0
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
10^3
duration (s)
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50Hz)
I_F
time
each current pulse is followed by the crest working reverse voltage
T_j = 190°C (prior to surge)


7Z58646
600
I_F
(A)
500
400
300
200
100
0
0
0.5
1
1.5
V_F (V)
2
T_j = 25°C
T_j = 190°C
typ
max


7Z59115
transient thermal impedance from junction to mounting base versus time
$Z_{th\ j-mb}$ (°C/W)
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-3}
10^{-2}
10^{-1}
1
10
10^{2}
time (s)
10^{3}

SILICON RECTIFIER DIODES

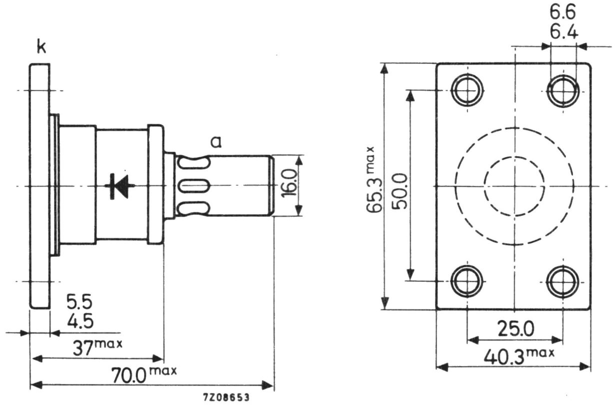
Diffused silicon diodes in metal envelopes with ceramic insulation, intended for power rectifier application. The series consists of the following types:
Normal polarity (cathode to stud): BYX33-400 to 1600
Reverse polarity (anode to stud) : BYX33-400R to 1600R

QUICK REFERENCE DATA

			BYX33-400(R)	600(R)	800(R)	1000(R)	1200(R)	1600(R)	
Crest working reverse voltage	V_{RWM}	max.	400	600	800	1000	1200	**1200**	V
Repetitive peak reverse voltage	V_{RRM}	max.	400	600	800	1000	1200	1600	V

Average forward current up to T_{mb} = 120 °C	$I_{F(AV)}$	max.	250	A
water cooled up to T_{mb} = 55 °C	$I_{F(AV)}$	max.	400	A
Non-repetitive peak forward current t = 10 ms; T_j = 190 °C prior to surge	I_{FSM}	max.	4000	A
Operating junction temperature	T_j	max.	190	°C

MECHANICAL DATA Dimensions in mm



Net weight: 230 g
Normal polarity (cathode to stud, ◀): blue circle on top.
Reverse polarity (anode to stud, ▶): red circle on top.
Accessories and mounting instructions: see page 3.

All information applies to frequencies up to 400 Hz.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages [1]

			BYX33-400(R)	600(R)	800(R)	1000(R)	1200(R)	1600(R)	
Continuous reverse voltage	V_R	max.	400	600	800	1000	1200	1200	V
Crest working reverse voltage	V_{RWM}	max.	400	600	800	1000	1200	1200	V
Repetitive peak reverse voltage	V_{RRM}	max.	400	600	800	1000	1200	1600	V
Non-repetitive peak reverse voltage ($t \leq$ 10 ms)	V_{RSM}	max.	450	650	900	1100	1300	1600	V

Currents

Average forward current (averaged over any 20 ms period) up to T_{mb} = 120 °C	$I_{F(AV)}$	max.	250	A
water cooled up to T_{mb} = 55 °C	$I_{F(AV)}$	max.	400	A
Forward current (d.c.)	I_F	max.	625	A
R.M.S. forward current	$I_{F(RMS)}$	max.	625	A
Repetitive peak forward current	I_{FRM}	max.	2000	A
Non-repetitive peak forward current (t = 10 ms; half sine wave) T_j = 190 °C prior to surge	I_{FSM}	max.	4000	A
I squared t for fusing (t = 10 ms)	I^2t	max.	80000	A^2s

Temperatures

Storage temperature	T_{stg}		−55 to +200	°C
Operating junction temperature	T_j	max.	190	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	= 0.2	°C/W
From mounting base to heatsink without heatsink compound	$R_{th\ mb\text{-}h}$	= 0.07	°C/W
with heatsink compound (e.g. Dow Corning 340)	$R_{th\ mb\text{-}h}$	= 0.03	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	= 0.02	°C/W

---

[1] To ensure thermal stability $R_{th\ j\text{-}a} \leq 0.7$ °C/W (continuous reverse voltage) or ≤ 1.3 °C/W (a.c.)

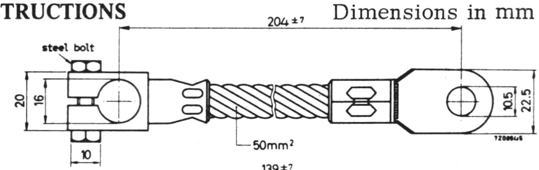
CHARACTERISTICS

		BYX33-400(R)	600(R)	800(R)	1000(R)	1200(R)	1600(R)	
Forward voltage I_F = 1250 A; T_j = 25 °C	V_F <	1.7	1.7	1.7	1.7	1.7	1.7	V[1]
Peak reverse current $V_{RM} = V_{RWM}$; T_j = 175 °C	I_{RM} <	50	42	32	25	20	20	mA

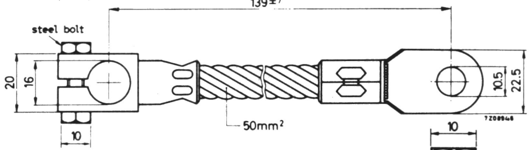
ACCESSORIES AND MOUNTING INSTRUCTIONS

Dimensions in mm

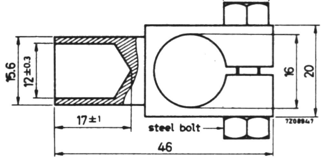
Flexible top lead
Type number 56243
Weight: 170 g


204 ±7
steel bolt
20
16
10
50mm²
10.5
22.5
7Z08945

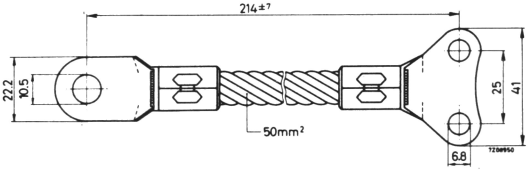
Flexible top lead
Type number 56243A
Weight: 140 g


139 ±7
steel bolt
20
16
10
50mm²
10.5
22.5
7Z08946

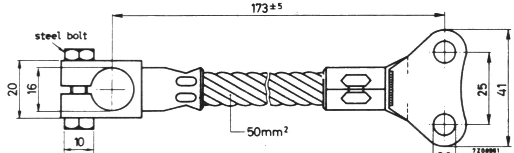
Clamp
Type number 56244
Weight: 70 g


10
15.6
12±0.3
16
20
17±1
steel bolt
46
7Z08947

Flexible base lead
Type number 56247
Weight: 135 g


214 ±7
22.2
10.5
50mm²
25
41
6.8
7Z08950

Flexible top lead for series connection
Type number 56296
Weight: 155 g


173 ±5
steel bolt
20
16
10
50mm²
25
41
6.8
7Z08951

1. These accessories are supplied on request.
2. For mounting of the flexible top lead it is recommended to use two spanners to avoid damage.
   Torque on nut: min. 30 kg cm (3 Newton-metres); max. 60 kg cm (6 Newton-metres)
3. For mounting the diode on a heatsink use steel bolts.
   Min. torque for good thermal and electrical contact: 30 kg cm (3 Newton-metres)
   Max. torque : 60 kg cm (6 Newton-metres)
4. Top lead 56243 should only be used for $I_{F(RMS)} \leq$ 400 A
   Top lead 56243 is necessary for $I_{F(RMS)} >$ 400 A to prevent excessive temperature of the top connection.

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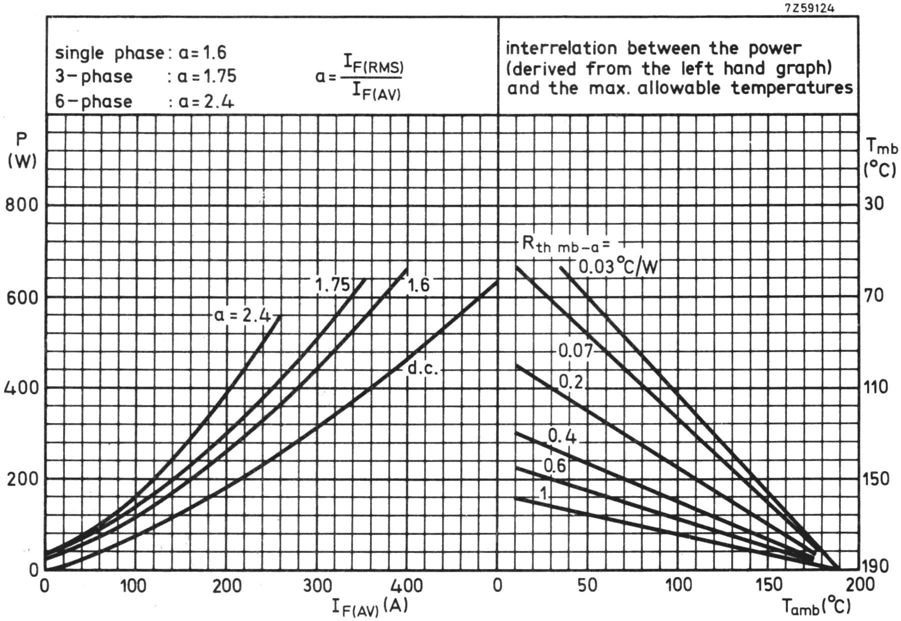
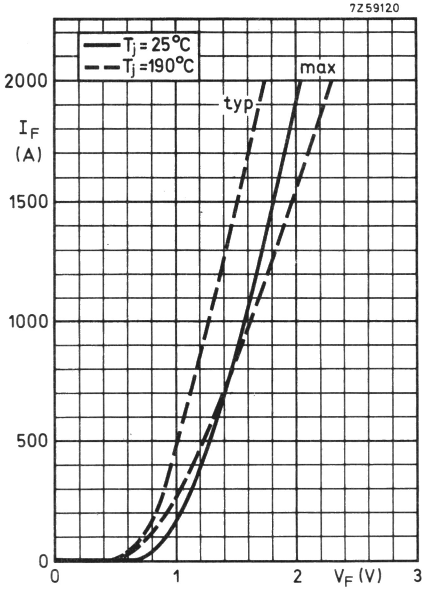
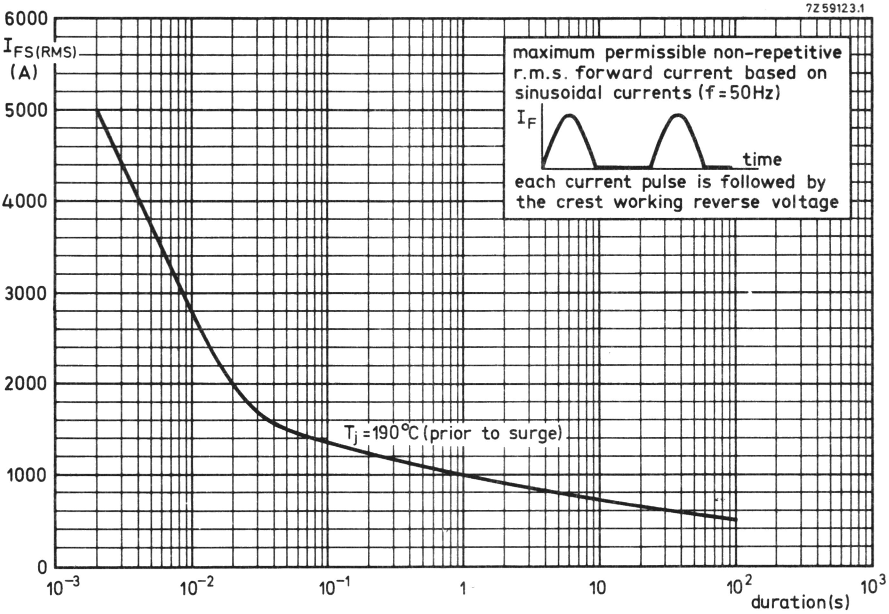
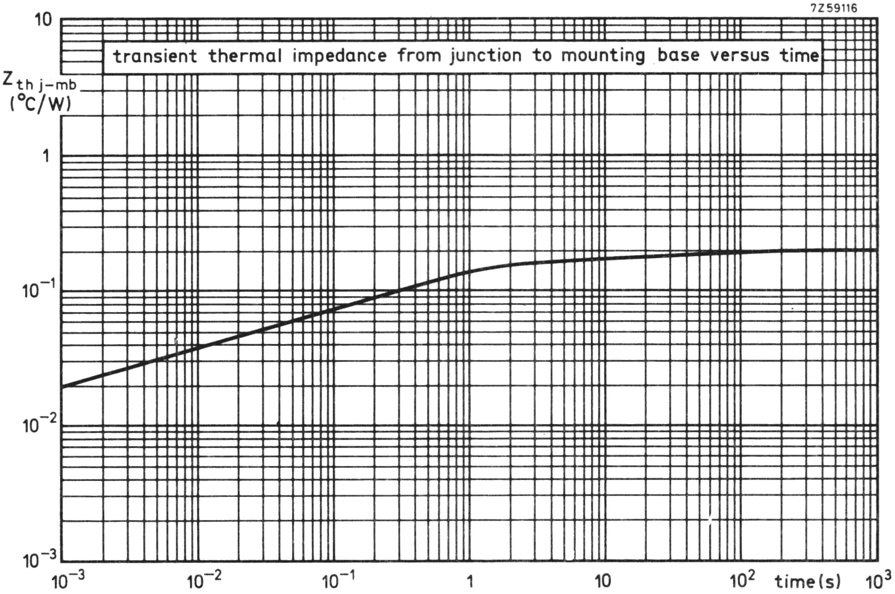
[1] Measured under pulsed conditions to avoid excessive dissipation.


7Z59124
single phase : a = 1.6
3-phase : a = 1.75
6-phase : a = 2.4
$a = \frac{I_{F(RMS)}}{I_{F(AV)}}$
interrelation between the power (derived from the left hand graph) and the max. allowable temperatures
P (W)
800
600
400
200
0
a = 2.4
1.75
1.6
d.c.
0
100
200
300
400
0
$I_{F(AV)}$ (A)
$R_{th\ mb-a}$ = 0.03 °C/W
0.07
0.2
0.4
0.6
1
50
100
150
200
T_{amb} (°C)
T_{mb} (°C)
30
70
110
150
190


7Z59120
T_j = 25 °C
T_j = 190 °C
typ
max
I_F (A)
2000
1500
1000
500
0
0
1
2
3
V_F (V)


7Z59123.1
6000
$I_{FS(RMS)}$
(A)
5000
4000
3000
2000
1000
0
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50Hz)
I_F
time
each current pulse is followed by the crest working reverse voltage
T_j = 190°C (prior to surge)
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
10^3
duration (s)


7Z59116
10
transient thermal impedance from junction to mounting base versus time
$Z_{th\ j-mb}$
(°C/W)
1
10^{-1}
10^{-2}
10^{-3}
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
time (s)
10^3

APPLICATION INFORMATION AND OPERATING NOTES

See general pages at the beginning of this section.

FAST RECOVERY RECTIFIER DIODES WITH CONTROLLED AVALANCHE

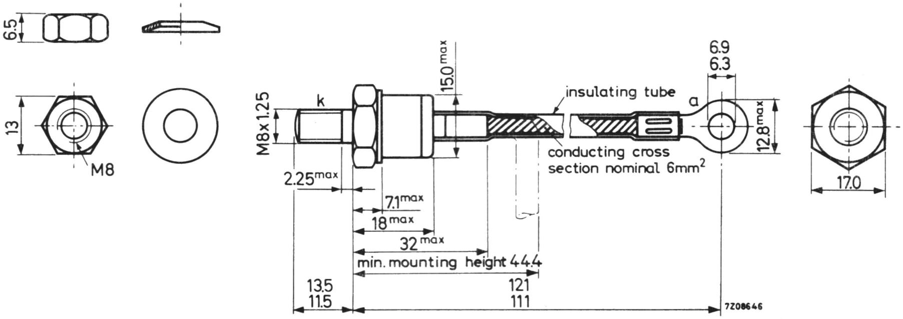
Diffused silicon diodes in a metal envelope, capable of absorbing transients. They are primarily intended for use in high frequency power supplies, inverters, choppers, sonar power supplies and ultra sonic systems.
The series consists of the normal polarity types (cathode to stud) BYX34-200 to BYX34-500.

QUICK REFERENCE DATA

			BYX34 – 200	300	400	500	
Crest working reverse voltage	V_{RWM}	max.	200	300	400	500	V
Reverse avalanche breakdown voltage	$V_{(BR)R}$	>	250	375	500	625	V
Average forward current up to $T_{mb} = 105\ ^{\circ}C$	$I_{F(AV)}$	max.	70				A
at $T_{mb} = 125\ ^{\circ}C$	$I_{F(AV)}$	max.	40				A
Non-repetitive peak forward current $t = 10$ ms; $T_j = 150\ ^{\circ}C$ prior to surge	I_{FSM}	max.	1200				A
Non-repetitive peak reverse power dissipation ($t = 10\ \mu s$; $T_j = 25\ ^{\circ}C$)	P_{RSM}	max.	30				kW
Junction temperature	T_j	max.	150				°C
Reverse recovery time when switched from $I_F = 50$ A to $V_R = 30$ V with $-dI/dt = 50\ A/\mu s$; $T_j = 25\ ^{\circ}C$	t_{rr}	<	0.7				μs

MECHANICAL DATA

Dimensions in mm


6.5
13
M8
M8x1.25
k
15.0 max
insulating tube
a
6.9
6.3
12.8 max
conducting cross section nominal 6mm²
2.25 max
7.1 max
18 max
32 max
min. mounting height 44.4
13.5
11.5
121
111
17.0
7Z08646

Net weight: 42 g
Diameter of clearance hole: max. 8.5 mm

Torque on nut: min 40 kg cm
(4 Newton-metres)
max. 60 kg cm
(6 Newton-metres)

All information applies to frequencies up to 50 kHz.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages [1]

		BYX34 –	200	300	400	500	
Continuous reverse voltage	V_R	max.	200	300	400	500	V
Crest working reverse voltage	V_{RWM}	max.	200	300	400	500	V

Currents

Average forward current (averaged over any 20 ms period) up to T_{mb} = 105 °C	$I_{F(AV)}$	max.	70	A
at T_{mb} = 125 °C	$I_{F(AV)}$	max.	40	A
Forward current (d.c.)	I_F	max.	120	A
R.M.S. forward current	$I_{F(RMS)}$	max.	120	A
Repetitive peak forward current	I_{FRM}	max.	1000	A
Non-repetitive peak forward current (t = 10 ms; half sine wave) T_j = 150 °C prior to surge	I_{FSM}	max.	1200	A
I squared t for fusing (t = 10 ms)	I^2t	max.	7200	A^2s
Rate of change of commutation current	$-\frac{dI}{dt}$	max.	100	A/µs

Reverse power dissipation

Repetitive peak reverse power dissipation t = 10 µs (square wave; f = 50 Hz) T_j = 150 °C	P_{RRM}	max.	8	kW
Non-repetitive peak reverse power dissipation; t = 10 µs (square wave) T_j = 25 °C prior to surge	P_{RSM}	max.	30	kW
T_j = 150 °C prior to surge	P_{RSM}	max.	15	kW

Temperatures

Storage temperature	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

---

[1] To ensure thermal stability $R_{th\ j\text{-}a} \leq 0.75$ °C/W (continuous reverse voltage) or ≤ 15 °C/W (a.c.)
For smaller heatsinks $T_{j\,max}$ should be derated. For a.c. see page 4.
For continuous reverse voltage: $R_{th\ j\text{-}a}$ = 1 °C/W, then $T_{j\,max}$ = 145 °C
$R_{th\ j\text{-}a}$ = 1.2 °C/W, then $T_{j\,max}$ = 140 °C

THERMAL RESISTANCE

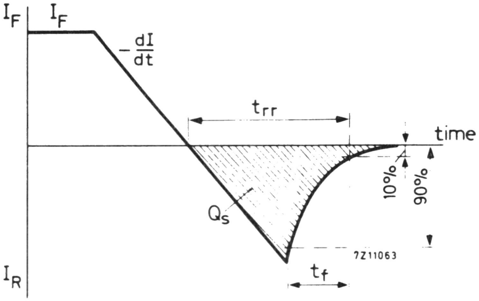
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	0.4	°C/W
From mounting base to heatsink				
without heatsink compound	$R_{th\ mb\text{-}h}$	=	0.4	°C/W
with heatsink compound (e.g. Dow Corning 340)	$R_{th\ mb\text{-}h}$	=	0.2	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.045	°C/W

CHARACTERISTICS

			BYX34 – 200	300	400	500	
Forward voltage							
I_F = 250 A; T_j = 25 °C	V_F	<	1.8	1.8	1.8	1.8	V[1]
Reverse avalanche breakdown voltage							
I_R = 10 mA; T_j = 25 °C	$V_{(BR)R}$	>	250	375	500	625	V
		<	900	900	900	900	V
Peak reverse current							
$V_{RM} = V_{RWM\,max}$; T_j = 125 °C	I_{RM}	<	25	25	18	15	mA

Reverse recovery when switched
from I_F = 50 A to $V_R \geq$ 30 V
with – dI/dt = 50 A/µs; T_j = 25 °C

reverse recovery charge	Q_s	<	7.5	µC
reverse recovery time	t_{rr}	<	0.7	µs
fall time	t_f	<	0.3	µs



---

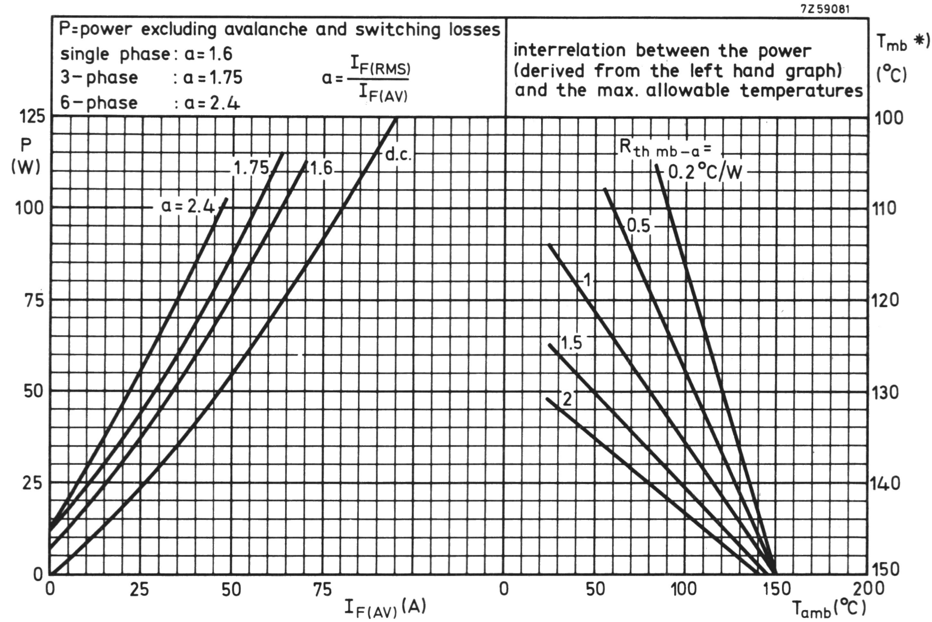
[1] Measured under pulsed conditions to avoid excessive dissipation.

OPERATING NOTES (See also general pages at the beginning of this section)

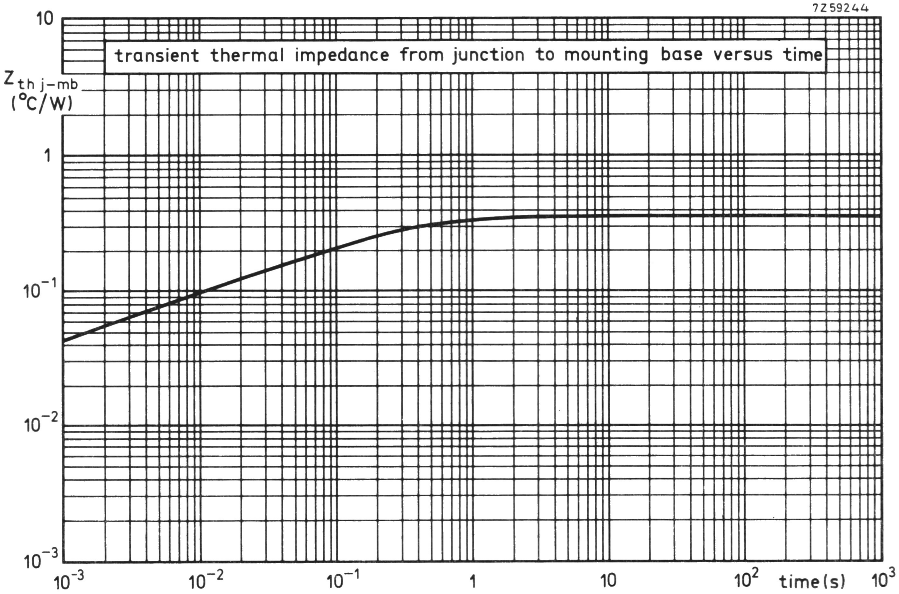
1. Square wave operation
   When I_F has been flowing sufficiently long for steady state to be established, there will be a charge due to minority carriers present. Before the device can block in the reverse direction this charge must be extracted. This extraction takes the form of a reverse transient (see figure on page 3). The majority of the power dissipation due to the reverse transient occurs during t_f as the rectifier gradually becomes reverse biased, and the mean power will be proportional to the operating frequency. The mean value of this power loss can be derived from the upper graph on page 5.
2. Sine wave operation
   Power loss in sine wave operation will be considerably less owing to the much slower rate of change of the applied voltage (and consequently lower values of $-dI/dt$), so that power loss due to reverse recovery may be safely ignored for frequencies up to 20 kHz.

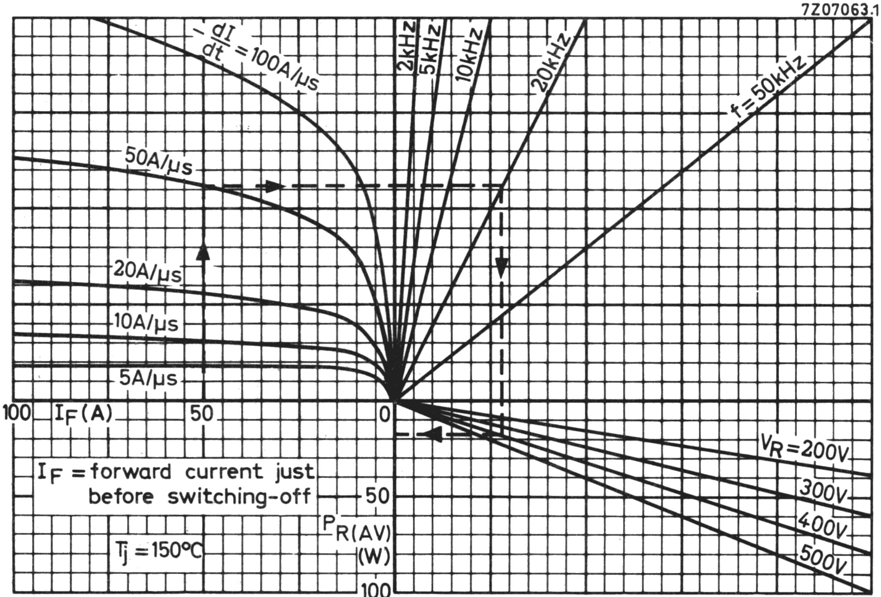
APPLICATION INFORMATION

See general pages of the beginning of this section.

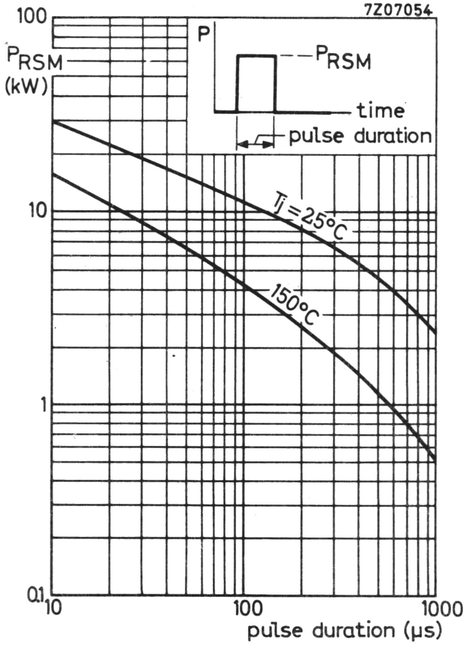


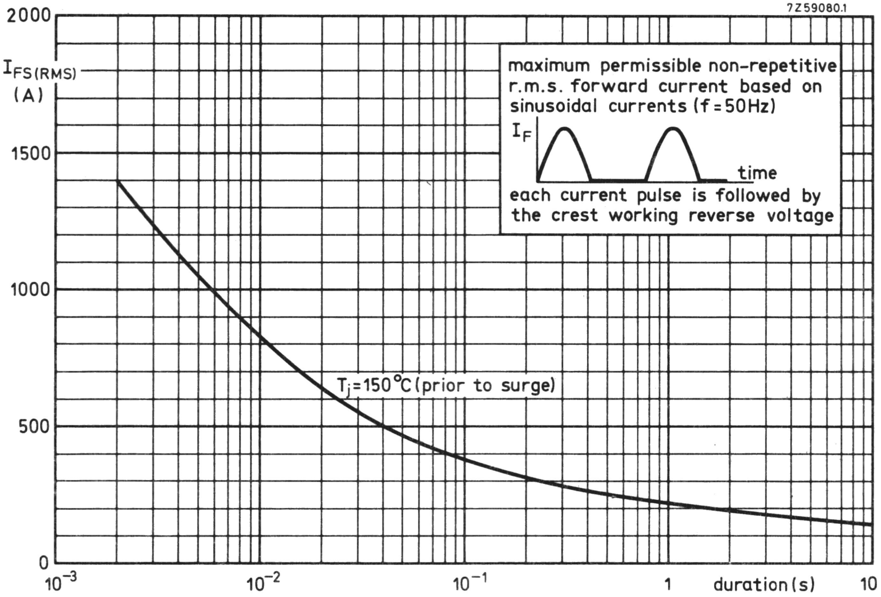
*) T_{mb}-scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leq 1.1\ ^{\circ}C/W$

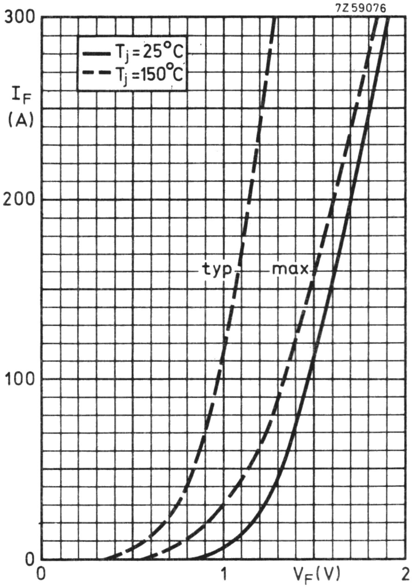


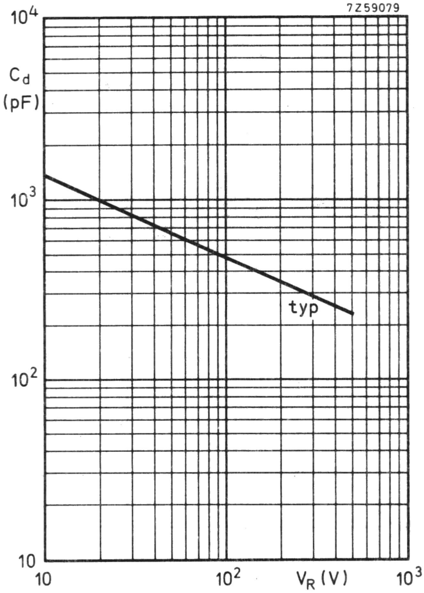


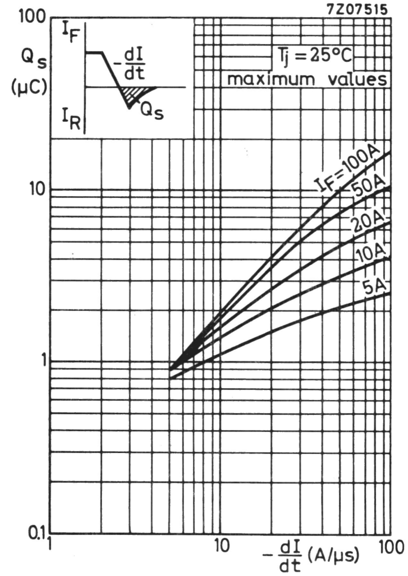
Nomogram: Power loss $P_{R(AV)}$ due to switching only (square wave operation)

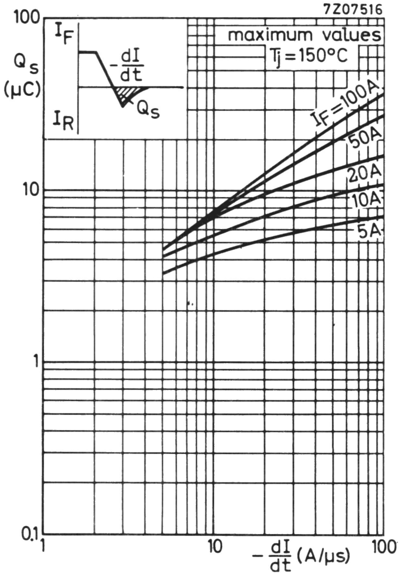


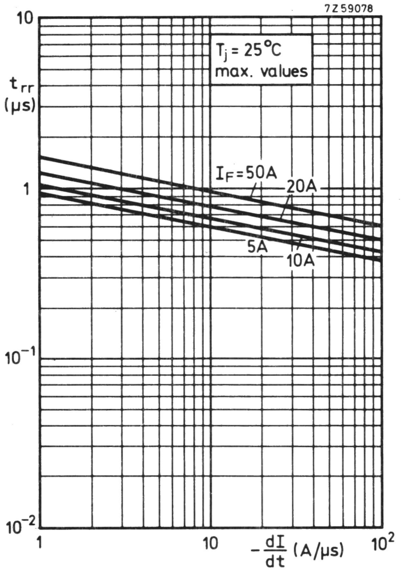

7Z59080.1
2000
1500
1000
500
0
$I_{FS(RMS)}$
(A)
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50Hz)
I_F
time
each current pulse is followed by the crest working reverse voltage
$T_j = 150°C$ (prior to surge)
10^{-3}
10^{-2}
10^{-1}
1
duration (s)
10

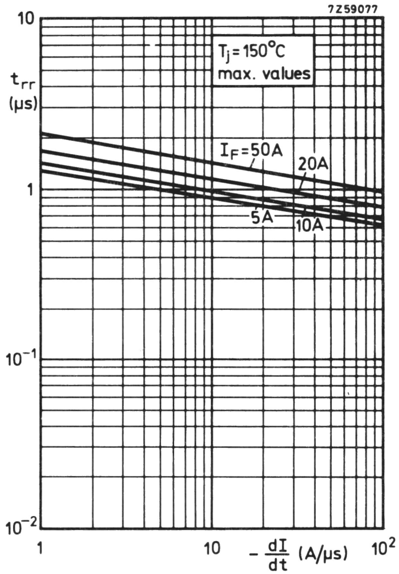

7Z59076
300
200
100
0
I_F
(A)
$T_j = 25°C$
$T_j = 150°C$
typ
max
0
1
V_F (V)
2


7Z59079
10^4
10^3
10^2
10
C_d
(pF)
typ
10
10^2
V_R (V)
10^3


7Z07515
100
10
1
0.1
Qs (μC)
IF
IR
-dI/dt
Qs
Tj = 25°C
maximum values
IF=100A
50A
20A
10A
5A
1
10
100
-dI/dt (A/μs)


7Z07516
100
10
1
0.1
Qs (μC)
IF
IR
-dI/dt
Qs
maximum values
Tj = 150°C
IF=100A
50A
20A
10A
5A
1
10
100
-dI/dt (A/μs)


7Z59078
10
1
10^{-1}
10^{-2}
trr (μs)
Tj = 25°C
max. values
IF=50A
20A
5A
10A
1
10
10^2
-dI/dt (A/μs)


7Z59077
10
1
10^{-1}
10^{-2}
trr (μs)
Tj = 150°C
max. values
IF=50A
20A
5A
10A
1
10
10^2
-dI/dt (A/μs)

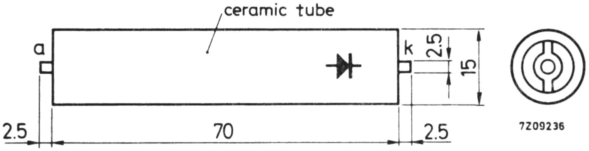
SILICON HIGH VOLTAGE DIODE

The BYX35 is primarily intended for the high voltage power supply of X-ray, electron microscope and LASER equipment.
The device is in a ceramic tube and must be immersed in oil for cooling and insulating.
The diodes can be connected in series, without voltage equalizing elements, for higher voltage applications.

QUICK REFERENCE DATA				
Crest working reverse voltage	V_{RWM}	max.	25	kV
Repetitive peak reverse voltage	V_{RRM}	max.	37.5	kV
Average forward current	I_{FAV}	max.	0.05	A
Non repetitive peak forward current t = 10 ms	I_{FSM}	max.	15	A

MECHANICAL DATA

Dimensions in mm



Net weight : 42 g
With accessories: 44 g

For mounting instructions see page 3.

All information applies to frequencies from 40 up to 400 Hz.

RATINGS (Limiting values) [1]

Voltages

Crest working reverse voltage	V_{RWM}	max.	25	kV
Repetitive peak reverse voltage	V_{RRM}	max.	37.5	kV
Non repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	40	kV

Currents

Continuous operation				
Average forward current (averaged over any 20 ms period) $T_{oil} \leq 50\,^{o}C$	I_{FAV}	max.	0.05	A
Repetitive peak forward current	I_{FRM}	max.	0.16	A
Non repetitive peak forward current ($t = 10$ ms)	I_{FSM}	max.	15	A
Intermittent operation				
Average forward current (averaged over any 20 ms period) $T_{oil} \leq 50\,^{o}C$ ($t \leq 0.5$ s once every 18 s)	I_{FAV}	max.	0.5	A
Repetitive peak forward current ($t \leq 0.5$ s once every 18 s)	I_{FRM}	max.	1.6	A

Temperatures

Storage temperature	T_{stg}		-65 to +125	^{o}C
Junction temperature	T_j	max.	125	^{o}C

THERMAL RESISTANCE

From junction to cooling oil	$R_{th\,j\text{-}o}$	=	8	$^{o}C/W$

CHARACTERISTICS

Forward voltage at $I_F = 10$ mA; $T_j = 25\,^{o}C$	V_F	typ.	25	V
Diode capacitance at $T_j = 25\,^{o}C$	C_d	typ.	45	pF

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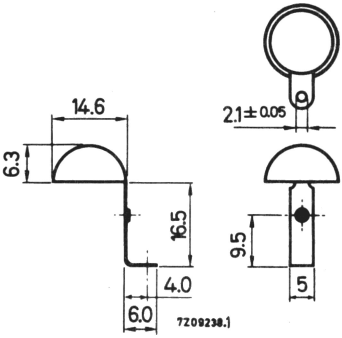
[1] Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

MOUNTING INSTRUCTIONS

Dimensions in mm

Each diode is supplied with 2 anti-corona caps.


14.6
6.3
16.5
4.0
6.0
2.1±0.05
9.5
5
7Z09238.1

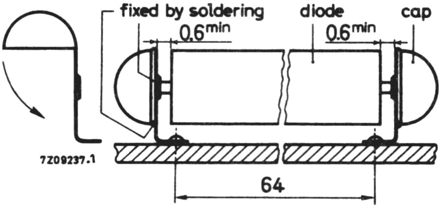
1. Mount clip on board.
2. Solder diode into fixing hole. Solder temperature: max. 300 °C; duration: max. 5 s.
3. Bend anti-corona cap down in direction of arrow and solder into position.

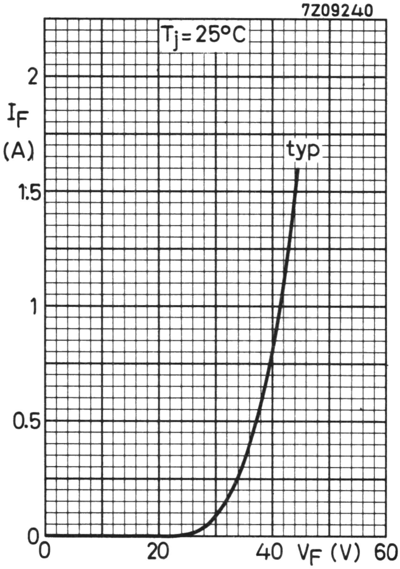
Notes:

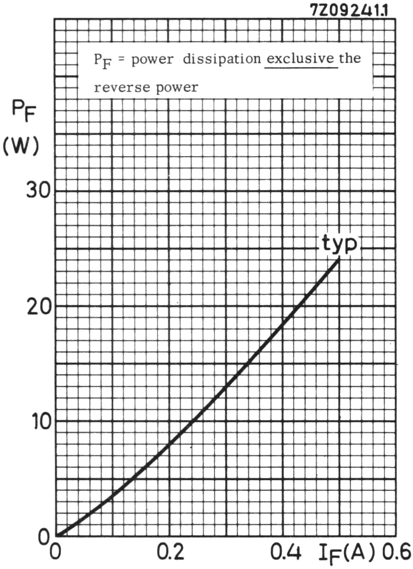
a. For good heat transfer and insulation, the devices must be immersed in oil.

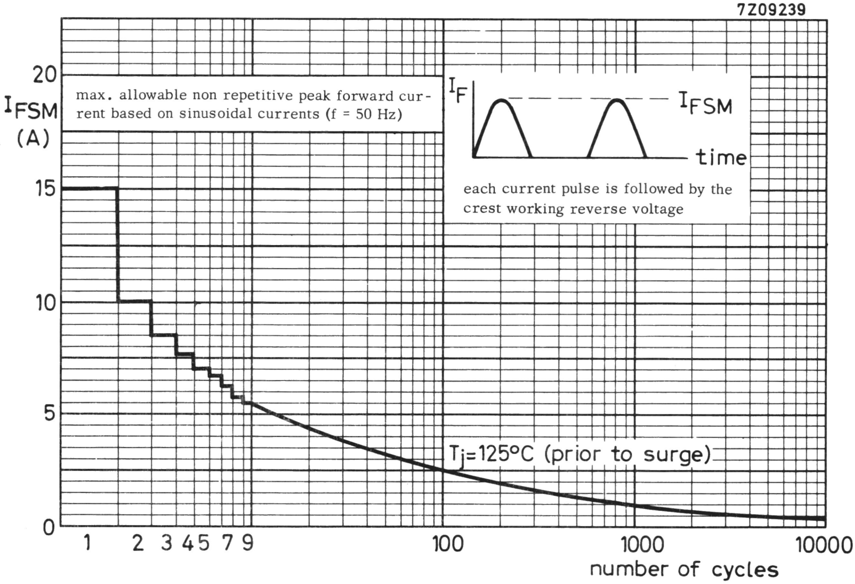
b. Any mounting position can be used.

c. Use acid free soldering flux.


fixed by soldering
0.6 min
diode
0.6 min
cap
64
7Z09237.1


7Z09240
$T_j = 25°C$
I_F (A)
2
1.5
1
0.5
0
typ
0
20
40
V_F (V)
60


7Z09241.1
P_F = power dissipation exclusive the reverse power
P_F (W)
30
20
10
0
typ
0
0.2
0.4
I_F(A)
0.6


7Z09239
max. allowable non repetitive peak forward current based on sinusoidal currents (f = 50 Hz)
I_{FSM} (A)
20
15
10
5
0
I_F
I_{FSM}
time
each current pulse is followed by the crest working reverse voltage
T_j=125°C (prior to surge)
1
2
3
4
5
7
9
100
1000
10000
number of cycles

SILICON RECTIFIER DIODES

Diffused silicon rectifier diodes in a DO-15 plastic envelope for general purposes. The series consists of the following types: BYX36-150, BYX36-300, BYX36-600.

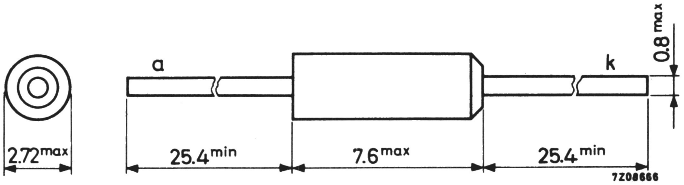
QUICK REFERENCE DATA

		BYX36-	150	300	600	
Crest working reverse voltage	V_{RWM}	max.	100	200	400	V
Repetitive peak reverse voltage	V_{RRM}	max.	150	300	600	V
Average forward current with R-load up to T_{amb} = 40 °C	$I_{F(AV)}$	max.		0.8		A
Non-repetitive peak forward current t = 10 ms; T_j = 125 °C prior to surge	I_{FSM}	max.		30		A
Junction temperature	T_j	max.		125		°C

MECHANICAL DATA

Dimensions in mm

DO-15



The coned end indicates the cathode

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages

			BYX36-150	300	600	
Continuous reverse voltage	V_R	max.	100	200	400	V
Crest working reverse voltage	V_{RWM}	max.	100	200	400	V
Repetitive peak reverse voltage ($\delta \leq 0.01$)	V_{RRM}	max.	150	300	600	V
Non-repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	150	300	600	V

Currents

Average forward current (averaged over any 20 ms period) for R-load up to $T_{amb} = 40\ ^{o}C$	$I_{F(AV)}$	max.	0.8	A
Forward current (d.c.) up to $T_{amb} = 40\ ^{o}C$	I_F	max.	0.9	A
Repetitive peak forward current	I_{FRM}	max.	5	A
Non-repetitive peak forward current $t = 10$ ms; half sine wave $T_j = 125\ ^{o}C$ prior to surge	I_{FSM}	max.	30	A

Temperatures

Storage temperature	T_{stg}		-55 to +125	^{o}C
Junction temperature	T_j	max.	125	^{o}C

CHARACTERISTICS

Forward voltage

$I_F = 1$ A; $T_j = 25\ ^{o}C$	V_F	typ. <	0.9 1.2	V 1) V 1)
$I_F = 5$ A; $T_j = 25\ ^{o}C$	V_F	typ.	1.1	V 1)

Peak reverse current

$V_{RM} = V_{RWMmax}$; $T_j = 125\ ^{o}C$	I_{RM}	<	120	μA

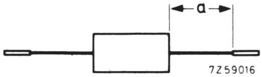
---

1) Measured under pulsed conditions to avoid excessive dissipation

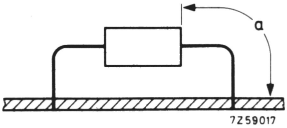
MOUNTING METHODS

The upper graph on page 4 applies when no other leads run to the tie–points. If leads of other dissipating components share the same tie–points, refer to the lower graph.

1. Mounted to solder tags at a lead-length a = 10 mm.
2. Mounted to solder tags at a = maximum lead-length.

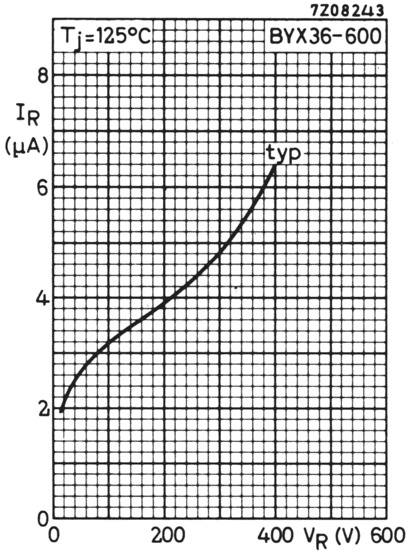


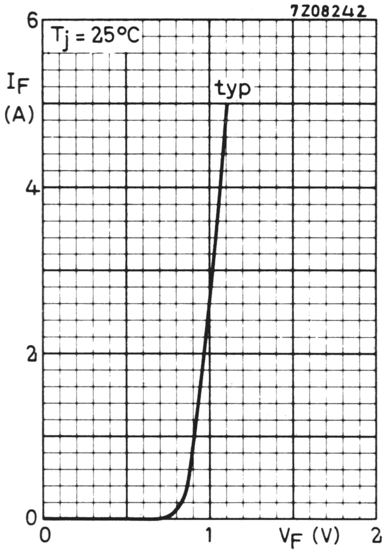
3. Mounted on printed-wiring board at a = maximum lead-length.
4. Mounted on printed-wiring board at a lead-length a = 10 mm.

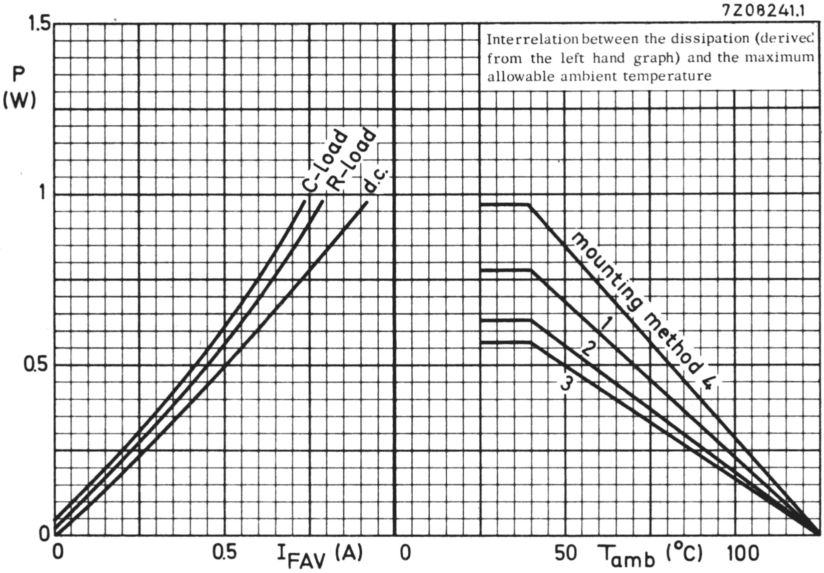


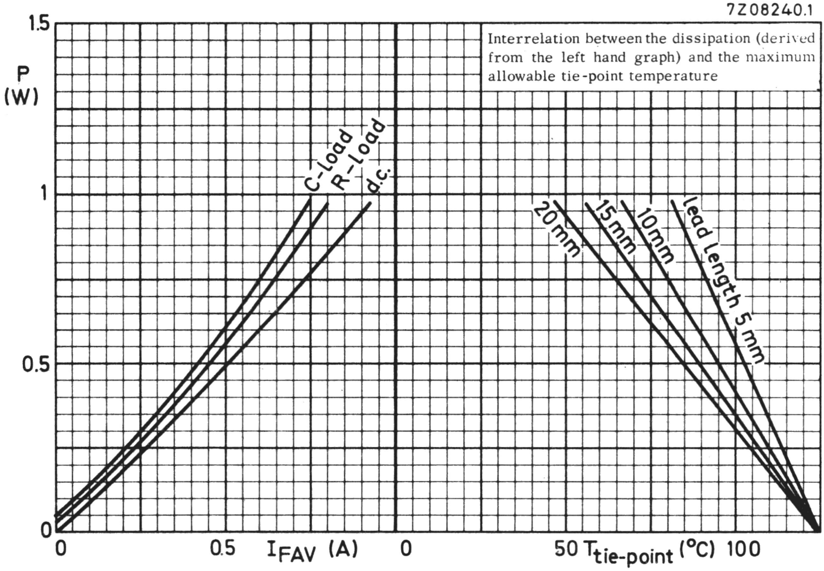
SOLDERING AND MOUNTING NOTES

1. Soldered joints must be at least 5 mm from the seal.
2. The maximum permissible temperature of the soldering iron or bath is 300 °C; it must be in contact with the joint for no more than 3 seconds.
3. Avoid hot spots due to handling or mounting; the body of the device must not come into contact with or be exposed to a temperature higher than 150 °C.






7Z08241.1
Interrelation between the dissipation (derived from the left hand graph) and the maximum allowable ambient temperature
P (W)
1.5
1
0.5
0
C-Load
R-Load
d.c.
0
0.5
I_{FAV} (A)
0
50
T_{amb} (°C)
100
mounting method 4
1
2
3


7Z08240.1
Interrelation between the dissipation (derived from the left hand graph) and the maximum allowable tie-point temperature
P (W)
1.5
1
0.5
0
C-Load
R-Load
d.c.
0
0.5
I_{FAV} (A)
0
50
$T_{tie-point}$ (°C)
100
20mm
15mm
10mm
lead length 5 mm

SILICON RECTIFIER DIODES

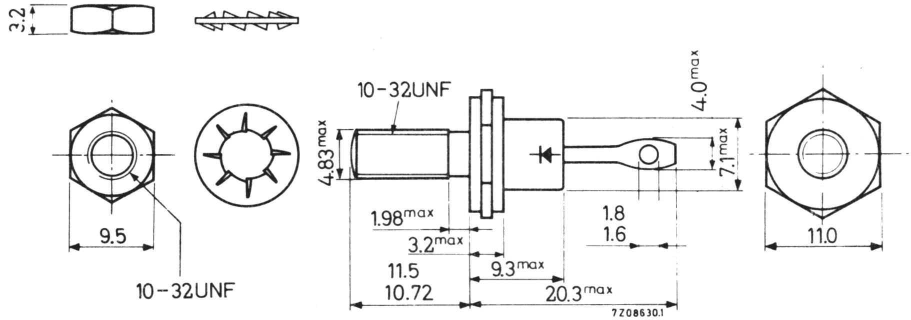
Diffused silicon rectifier diodes in a DO-4 metal envelope intended for power rectifier applications. The series consists of the following types.
Normal polarity (cathode to stud): BYX38-300 to 1200
Reverse polarity (anode to stud): BYX38-300R to 1200R

QUICK REFERENCE DATA

			BYX38-300(R)	600(R)	900(R)	1200(R)	
Crest working reverse voltage	V_{RWM}	max.	200	400	600	800	V
Repetitive peak reverse voltage	V_{RRM}	max.	300	600	900	1200	V
Average forward current up to $T_{mb} = 75\,^{o}C$	$I_{F(AV)}$	max.	6				A
at $T_{mb} = 125\,^{o}C$	$I_{F(AV)}$	max.	2.5				A
Non-repetitive peak forward current $t = 10\,ms$; $T_j = 150\,^{o}C$ prior to surge	I_{FSM}	max.	38				A
Junction temperature	T_j	max.	150				^{o}C

MECHANICAL DATA Dimensions in mm

DO-4



Net weight: 6.5 g
Diameter of clearance hole: max. 5.2 mm
Accessories supplied on request:
56295 (56262A)

Torque on nut: min. 8 kg cm
(0.8 Newton-metres)
max. 17 kg cm
(1.7 Newton-metres)
The mark shown applies to normal polarity types

All information applies to frequencies up to 400 Hz

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages			BYX38-300(R)	600(R)	900(R)	1200(R)	
Crest working reverse voltage	V_{RWM}	max.	200	400	600	800	V
Repetitive peak reverse voltage ($\delta \leq 0.01$)	V_{RRM}	max.	300	600	900	1200	V
Non-repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	300	600	900	1200	V

Currents

Average forward current (averaged over any 20 ms period) up to T_{mb} = 75 °C	$I_{F(AV)}$	max.	6.0	A
at T_{mb} = 125 °C	$I_{F(AV)}$	max.	2.5	A
Forward current (d.c.) up to T_{mb} = 90 °C	I_F	max.	6.0	A
at T_{mb} = 125 °C	I_F	max.	3.0	A
Repetitive peak forward current	I_{FRM}	max.	20	A
Non-repetitive peak forward current (t = 10 ms; half sine wave) T_j=150 °C prior to surge	I_{FSM}	max.	38	A
I^2t for fusing (t = 10 ms)	I^2t	max.	7.3	A^2s

Temperatures

Storage temperature	T_{stg}		−55 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	5	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.5	°C/W

CHARACTERISTICS

Forward voltage				
I_F = 5 A; T_j = 25 °C	V_F	<	1.7	V (1)
I_F = 15 A; T_j = 25 °C	V_F	<	2.1	V (1)

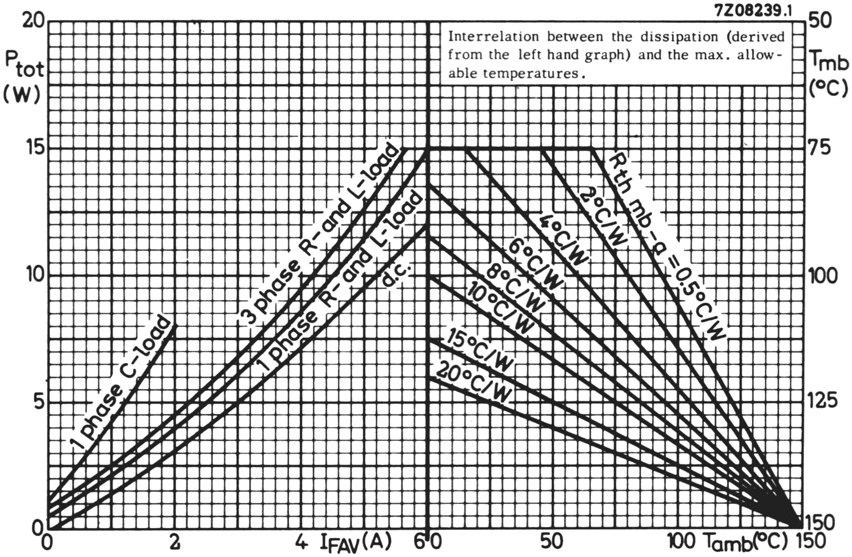
Peak reverse current					
	$V_R = V_{RWMmax}$; T_j = 25 °C	I_R	<	10	µA
	$V_R = V_{RWMmax}$; T_j = 125 °C	I_R	<	200	µA

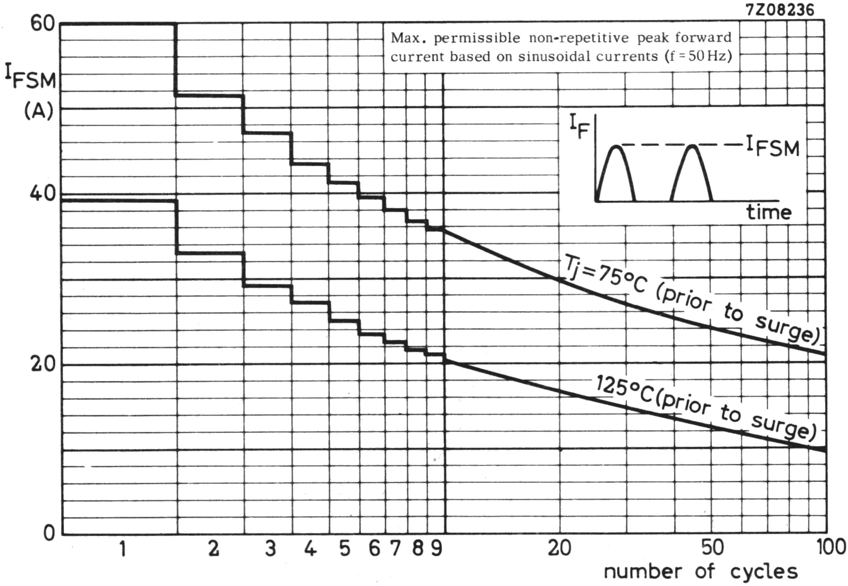
---

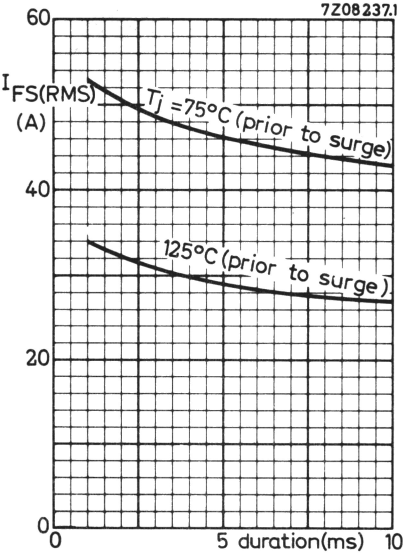
[1] Measured under pulsed conditions to avoid excessive dissipation.

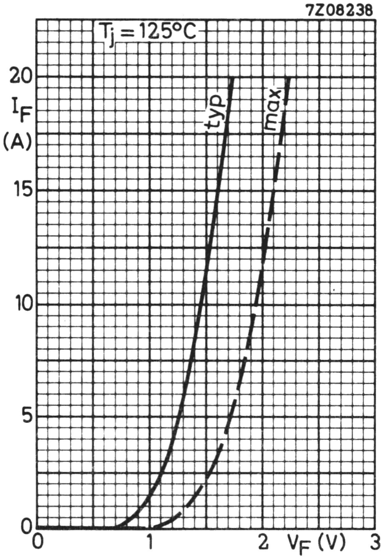
OPERATING NOTE (See also general pages at the beginning of this section)

The top connector should neither be bent nor twisted; it should be soldered into the circuit so that there is no strain on it.
During soldering the heat conduction to the junction should be kept to a minimum by using a thermal shunt.



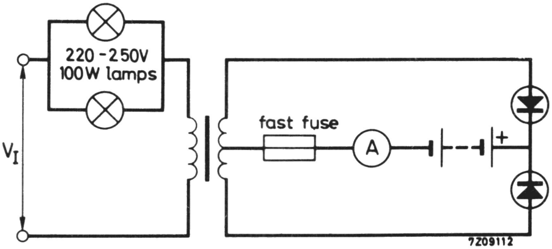

7Z08236
Max. permissible non-repetitive peak forward current based on sinusoidal currents (f = 50 Hz)
I_{FSM} (A)
60
40
20
0
I_F
I_{FSM}
time
T_j = 75 °C (prior to surge)
125 °C (prior to surge)
1
2
3
4
5
6
7
8
9
20
50
100
number of cycles


7Z08237.1
$I_{FS(RMS)}$ (A)
60
40
20
0
T_j = 75 °C (prior to surge)
125 °C (prior to surge)
0
5
duration (ms)
10


7Z08238
T_j = 125 °C
I_F (A)
20
15
10
5
0
typ
max
0
1
2
V_F (V)
3

APPLICATION INFORMATION

Protected battery charger with BYX38-300



Both rectifier diodes are mounted on a 15 cm x 15 cm vertically mounted blackened aluminium flat heatsink. Thickness 1.6 mm.

$V_{I(RMS)}$	Mean charging current for a battery voltage of:	
	6 V	12 V
220 V	5.6 A	3.4 A
250 V	5.0 A	3.4 A

Transformer data:

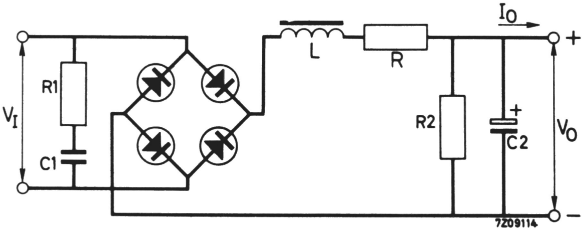
n (primary to half secondary)	0.094	
$V_{T(RMS)}$	150	V
$I_{primary}$ (rms)	0.75	A
$I_{secondary}$ (rms)	4.5	A
$I_{primary}$ (off-load saturation current with two 100 W lamps in parallel, connected in series with primary)	0.6	A

APPLICATION INFORMATION (continued)

Full wave rectifier circuit with choke input filter

Operating ambient temperature T_{amb} up to 50 °C

		BYX38-600(R)	900(R)	1200(R)	
R.M.S. input voltage	$V_{I(RMS)}$	130	200	250	V
Average output voltage	V_O	100	150	200	V
Average output current	I_O	0 to 4	0 to 4	0 to 4	A
Maximum ripple		0.5	0.5	0.5	%



Each diode is mounted on a 6 cm x 6 cm blackened aluminium cooling fin. Thickness 1.6 mm

Table of circuit components

	BYX38-600(R)	900(R)	1200(R)		
R1	220	220	390	Ω	1)
C1	1.0	1.0	0.5	μF	1)
L	0.5 (R = 3)	1.0 (R = 5)	1.0 (R = 5)	H Ω	
R2	200 (50)	300 (75)	400 (100)	Ω W	
C2	500	250	250	μF	

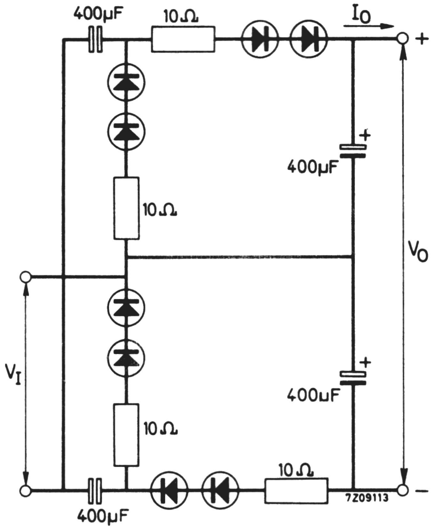
---

1) RC damping circuit; see operating notes on page 3.

APPLICATION INFORMATION (continued)

Voltage quadrupler circuit with BYX38-1200(R)

Operating ambient temperature	Tamb	up to	50	°C
R.M.S. input voltage	$V_{I(RMS)}$		220	V
Average output voltage	V_O		910	V
Average output current	I_O		840	mA


400µF
10Ω
I_O
+
400µF
10Ω
V_O
V_I
400µF
10Ω
10Ω
400µF
−
7Z09113

Each diode is mounted on a 4.5 cm x 4.5 cm blackened aluminium cooling fin. Thickness 1.6 mm.

CONTROLLED AVALANCHE RECTIFIER DIODES

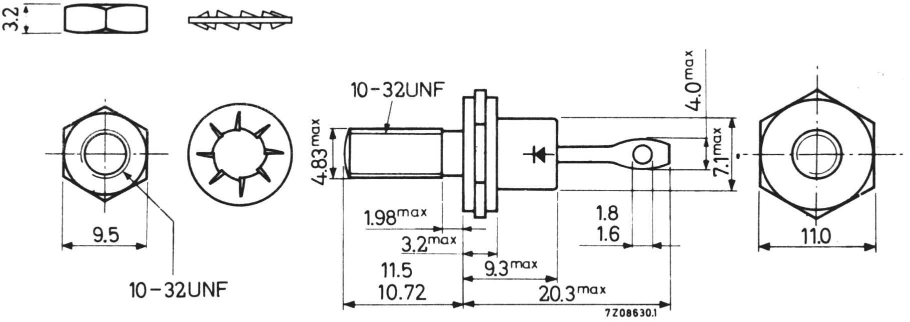
Silicon diodes in a DO-4 metal envelope, capable of absorbing transients and intended for power rectifier application.
The series consists of the following types:
Normal polarity (stud cathode): BYX39-600; BYX39-800; BYX39-1000
Reverse polarity (stud anode): BYX39-600R; BYX39-800R; BYX39-1000R

QUICK REFERENCE DATA

			BYX39-600(R)	800(R)	1000(R)	
Crest working reverse voltage	V_{RWM}	max.	600	800	1000	V
Average forward current	I_{FAV}	max.	6			A
Non repetitive peak forward current; t = 10 ms; T_j = 125 °C	I_{FSM}	max.	100			A
Repetitive peak reverse power t = 10 μs; T_j = 125 °C	P_{RRM}	max.	2			kW
Non repetitive peak reverse power t = 10 μs; T_j = 25 °C	P_{RSM}	max.	4			kW
Junction temperature	T_j	max.	175			°C

MECHANICAL DATA

DO-4
The mark shown applies to normal polarity types.



Net weight : 4.3 g
With accessories: 6.5 g
Diameter of hole in heatsink: max. 5.2 mm
Accessories available: 56295 (56262A)

Torque on nut: min. 8 cm kg
max. 17 cm kg

All information applies to frequencies up to 400 Hz

RATINGS (Limiting values) [1]

Voltages [2]

			BYX39-600(R)	800(R)	1000(R)	
Crest working reverse voltage	V_{RWM}	max.	600	800	1000	V

Currents

Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	6.0	A
Forward current (d.c.)	I_F	max.	6.8	A
R.M.S. forward current	$I_{F(RMS)}$	max.	9.5	A
Repetitive peak forward current	I_{FRM}	max.	120	A
Non repetitive peak forward current $t = 10$ ms; $T_j = 125$ °C; see also page 7	I_{FSM}	max.	100	A
I squared t for fusing	See curves at page 7			

Reverse power dissipation

Reverse power (averaged over any 20 ms period)	P_{RAV}	max.	10	W
Repetitive peak reverse power at f = 50 Hz square wave; $t = 10\ \mu s$; $T_j = 125$ °C (see also pages 5 and 6)	P_{RRM}	max.	2	kW
Non repetitive peak reverse power square wave; see also page 6 $t = 10\ \mu s$; $T_j = 25$ °C	P_{RSM}	max.	4	kW
$T_j = 175$ °C	P_{RSM}	max.	0.8	kW

Temperatures

Storage temperature	T_{stg}		-55 to +175	°C
Junction temperature	T_j	max.	175	°C

---

[1] Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

[2] To ensure thermal stability: $R_{th\ j\text{-}a} < 20$ °C/W (a.c.)
For smaller heatsinks T_j max. should be derated.
(see also page 5)

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	50 °C/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	4.5 °C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.5 °C/W

CHARACTERISTICS

			BYX39-600(R)	800(R)	1000(R)	
Voltages						
Forward voltage at						
I_F = 20 A; T_j = 25 °C	V_F	<	2.0	2.0	2.0	V [1]
Reverse breakdown voltage (see also page 8)						
I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	>	750	1000	1250	V
		<	1600	1600	1600	V
Currents						
Reverse current at T_j = 125 °C						
V_R = 600 V	I_R	<	150			μA
V_R = 800 V	I_R	<		150		μA
V_R = 1000 V	I_R	<			150	μA

OPERATING NOTES (See also general pages at the beginning of this section.)

1. Voltage sharing of series connected controlled avalanche diodes.

   If diodes with avalanche characteristics are connected in series, the usual R and C elements for voltage sharing can be omitted.
2. In order to prevent the diodes from being damaged by surge currents higher than those mentioned in the curves at page 7 a fast fuse is recommended.
3. The top connector should neither be bent nor twisted; it should be soldered into the circuit so there is no strain on it.
   During soldering the heat conduction to the junction should be kept to a minimum by using a thermal shunt.

---

1) Measured under pulsed conditions to avoid excessive dissipation.

Determination of the heatsink thermal resistance.

Example:

Assume a diode, used in a single phase rectifier circuit.

frequency	f	=	50	Hz	
average forward current	I_{FAV}	=	3	A	(per diode)
ambient temperature	T_{amb}	=	70	°C	
repetitive peak reverse power dissipation in the avalanche region	P_{RRM}	=	0.5	kW	(per diode)
duration of P_{RRM}	t	=	70	µs	

From the left hand part of the upper graph on page 5 it follows that at $I_{FAV} = 3$ A in a single phase rectifier circuit the average forward power + average leakage power = 4.9 W per diode (point A). The average reverse power in the avalanche region, averaged over any cycle, follows from:

$$P_{RAV} = \delta \times P_{RRM}, \text{ where the duty cycle } \delta = \frac{70\ \mu s}{20\ ms} = 0.0035$$

Thus: $P_{RAV} = 0.0035 \times 0.5\ kW = 1.75\ W$.

Therefore the total device power dissipation $P_{tot} = (4.9 + 1.75)\ W = 6.65\ W$ (point B).

In order to avoid excessive peak junction temperatures resulting from the pulse character to the repetitive peak reverse power in the avalanche region, the value of the maximum junction temperature should be reduced. If the repetitive peak reverse power in the avalanche region is 0.5 kW; t = 70 µs; f = 50 Hz, the maximum allowable junction temperature should be 167 °C instead of 175 °C, thus 8 °C lower (see the lower graph on page 5).

Allowance can be made for this by assuming an ambient temperature 8 °C higher than before, in this case 78 °C instead of 70 °C.

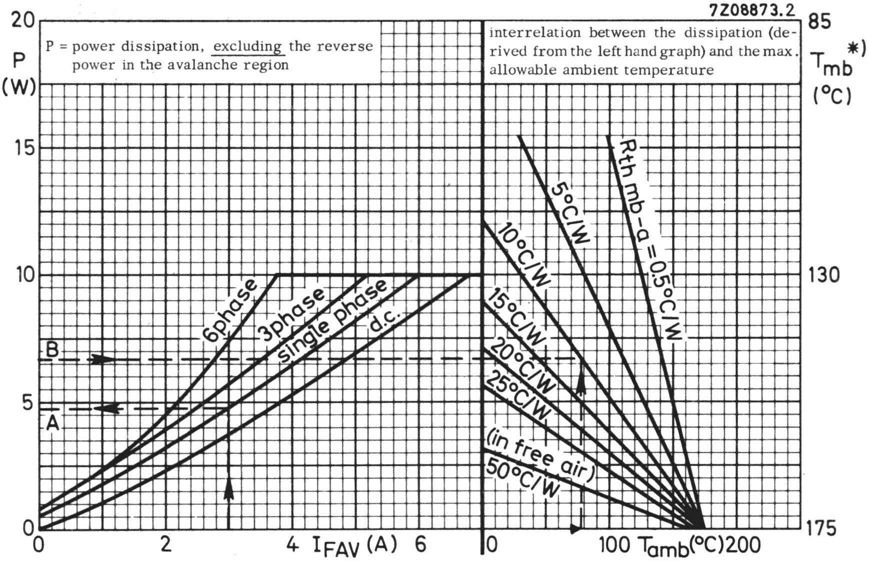
Using this in the curve leads to a thermal resistance

$$R_{th\ mb-a} \approx 10\ ^{\circ}C/W$$

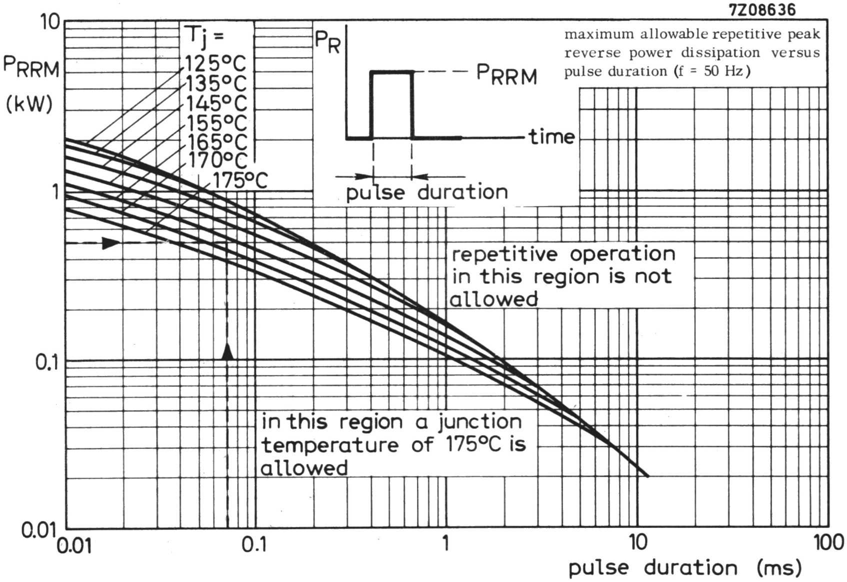
The contact thermal resistance $R_{th\ mb-h} = 0.5\ ^{\circ}C/W$.
Hence the heatsink thermal resistance should be:

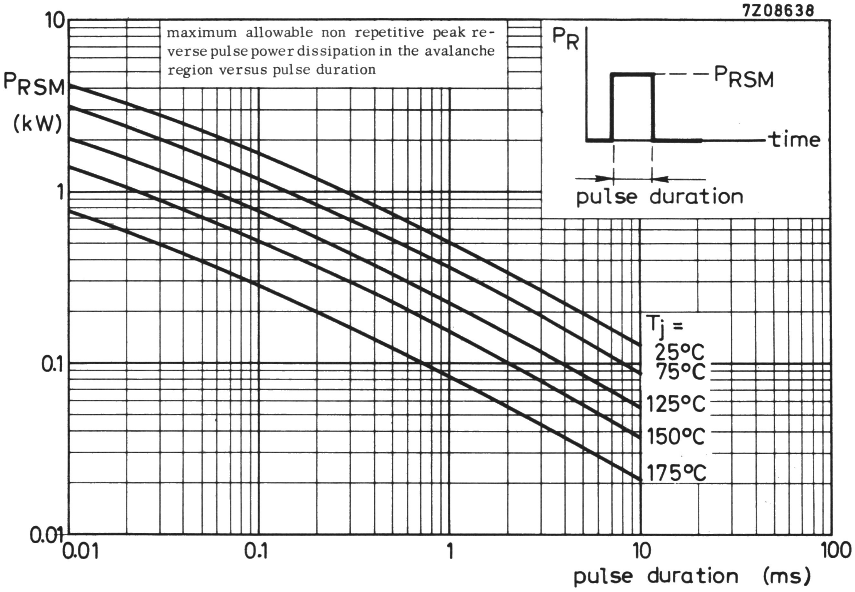
$$R_{th\ h-a} = R_{th\ mb-a} - R_{th\ mb-h} = (10 - 0.5)\ ^{\circ}C/W = 9.5\ ^{\circ}C/W$$

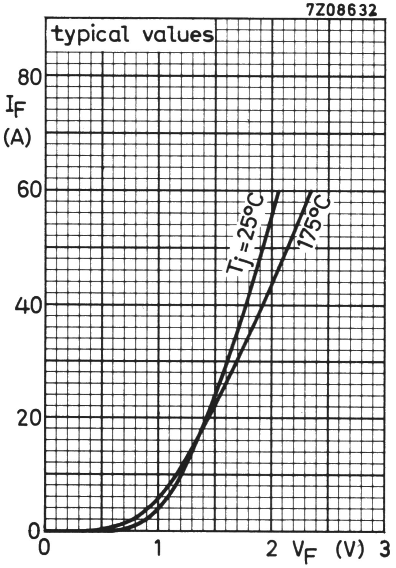
The applicable heatsink(s) may then be found in the Section HEATSINKS.

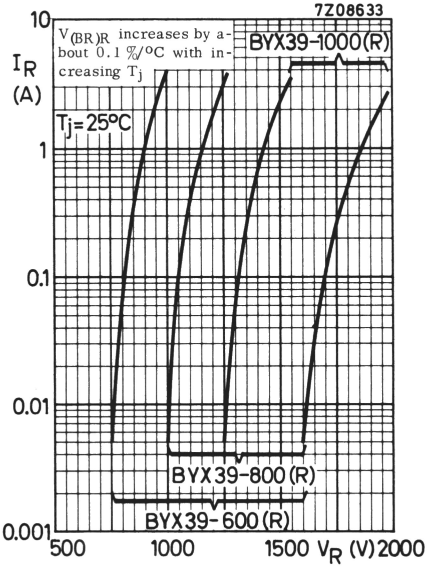


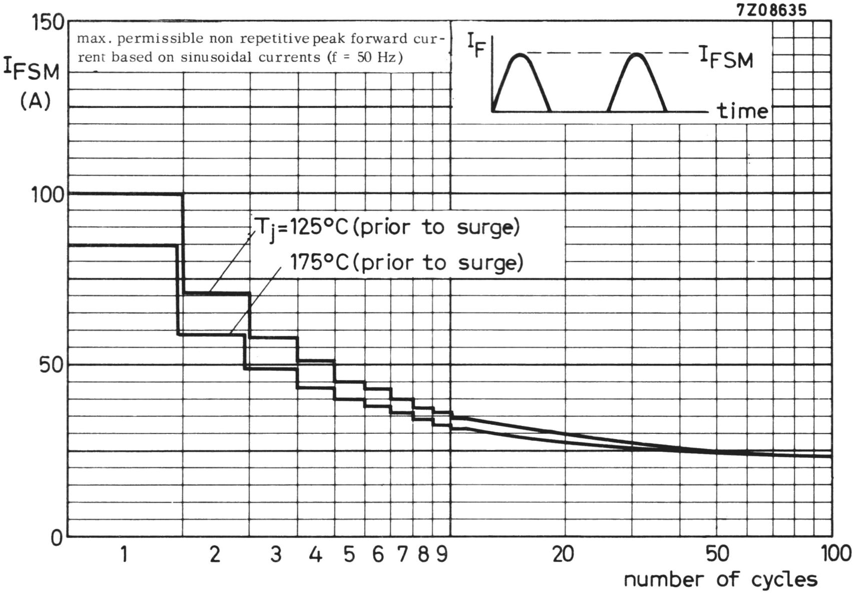
✱ T_{mb}-scale is for comparison purposes only and is correct only for R_{th} mb-a < 15.5 °C/W

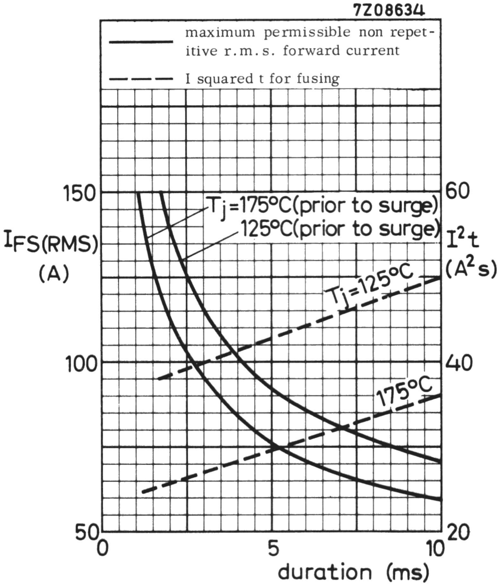



maximum allowable non repetitive peak reverse pulse power dissipation in the avalanche region versus pulse duration




$V_{(BR)R}$ increases by about 0.1 %/°C with increasing T_j


7Z08635
max. permissible non repetitive peak forward current based on sinusoidal currents (f = 50 Hz)
I_F
I_{FSM}
time
I_{FSM}
(A)
150
100
50
0
T_j=125°C (prior to surge)
175°C (prior to surge)
1
2
3
4
5
6
7
8
9
20
50
100
number of cycles


7Z08634
maximum permissible non repetitive r.m.s. forward current
I squared t for fusing
$I_{FS(RMS)}$
(A)
150
100
50
T_j=175°C(prior to surge)
125°C(prior to surge)
T_j=125°C
175°C
60
I^2t
(A^2s)
40
20
0
5
10
duration (ms)

CONTROLLED AVALANCHE RECTIFIER DIODES

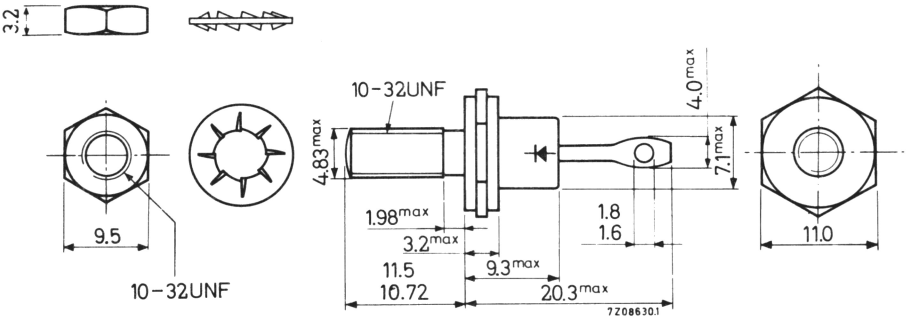
Diffused silicon diodes in a DO-4 metal envelope, capable of absorbing transients and intended for power rectifier applications.
The series consists of the following types:
Normal polarity (cathode to stud): BYX40-600, BYX40-800, BYX40-1000.
Reverse polarity (anode to stud): BYX40-600R, BYX40-800R, BYX40-1000R.

QUICK REFERENCE DATA

			BYX40-600(R)	800(R)	1000(R)	
Crest working reverse voltage	V_{RWM}	max.	600	800	1000	V
Reverse avalanche breakdown voltage	$V_{(BR)R}$	>	750	1000	1250	V
Average forward current up to T_{mb} = 125 °C	$I_{F(AV)}$	max.	12			A
Non-repetitive peak forward current; t = 10 ms; T_j = 175 °C prior to surge	I_{FSM}	max.	180			A
Non-repetitive peak reverse power t = 10 µs; T_j = 25 °C	P_{RSM}	max.	8			kW
Junction temperature	T_j	max.	175			°C

MECHANICAL DATA Dimensions in mm

DO-4
The mark shown applies to normal polarity types.



Net weight : 6.5 g

Diameter of clearance hole: max. 5.2 mm
Accessories supplied on request: 56295 (56262A)

Torque on nut: min. 8 kg cm
(0.8 Newton-metres)
max. 17 kg cm
(1.7 Newton-metres)

All information applies to frequencies **up to 400 Hz**

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

			BYX40-600(R)	800(R)	1000(R)	
Crest working reverse voltage	V_{RWM}	max.	600	800	1000	V

Currents

Average forward current up to T_{mb} = 125 °C (averaged over any 20 ms period)	$I_{F(AV)}$	max.	12	A
Forward current (d.c.) at T_{mb} = 125 °C	I_F	max.	19	A
R.M.S. forward current	$I_{F(RMS)}$	max.	19	A
Repetitive peak forward current	I_{FRM}	max.	250	A
Non-repetitive peak forward current t = 10 ms; half sine wave T_j = 175 °C prior to surge	I_{FSM}	max.	180	A
I^2t for fusing (t = 10 ms)	I^2t	max.	162	A^2s

RATINGS (continued)

Reverse power dissipation

Repetitive peak reverse power dissipation t = 10 μs (square wave: f = 50 Hz) T_j = 175 °C	P_{RRM}	max.	1.2	kW
Non-repetitive peak reverse power dissipation; t = 10 μs T_j = 25 °C prior to surge	P_{RSM}	max.	8	kW
T_j = 175 °C prior to surge	P_{RSM}	max.	1.2	kW

Temperatures

Storage temperature	T_{stg}		−55 to +175	°C
Junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	50	°C/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	2.2	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.5	°C/W

CHARACTERISTICS

Voltages

			BYX40-600(R)	800(R)	1000(R)	
Forward voltage at I_F = 50 A; T_j = 25 °C	V_F	<	2.5	2.5	2.5	V [1]
Reverse avalanche breakdown voltage I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	>	750	1000	1250	V [2]
		<	2000	2000	2000	V

Current

Peak reverse current at T_j = 125 °C $V_{RM} = V_{RWMmax}$	I_{RM}	<	300	μA

OPERATING NOTES (See also general pages at the beginning of this section)

1. Voltage sharing of series connected controlled avalanche diodes.
   If diodes with avalanche characteristics are connected in series, the usual R and C elements for voltage sharing can be omitted.
2. The top connector should neither be bent not twisted; it should be soldered into the circuit so that there is no strain on it.
   During soldering the heat conduction to the junction should be kept to a minimum by using a thermal shunt.

APPLICATION INFORMATION See general pages at the beginning of this section.

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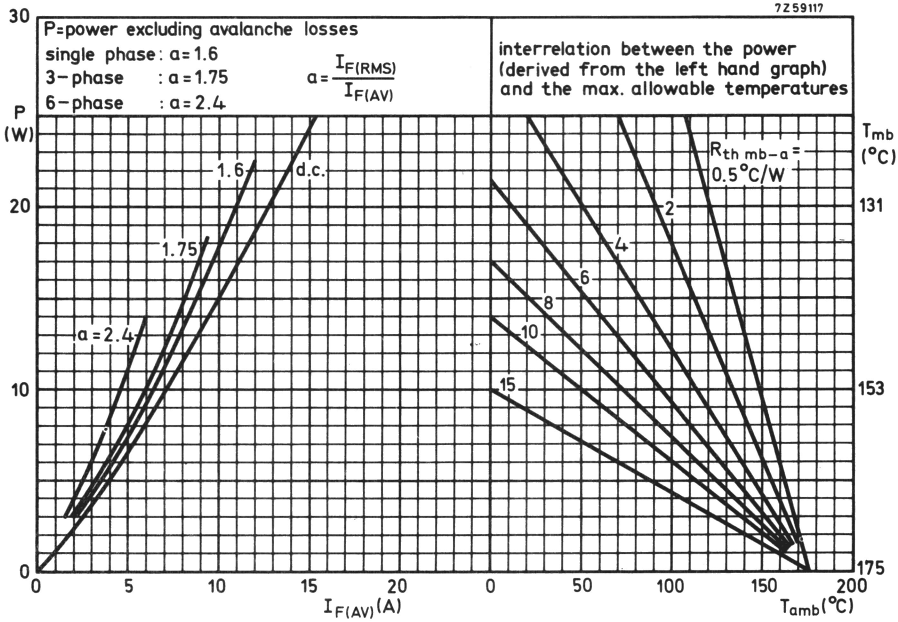
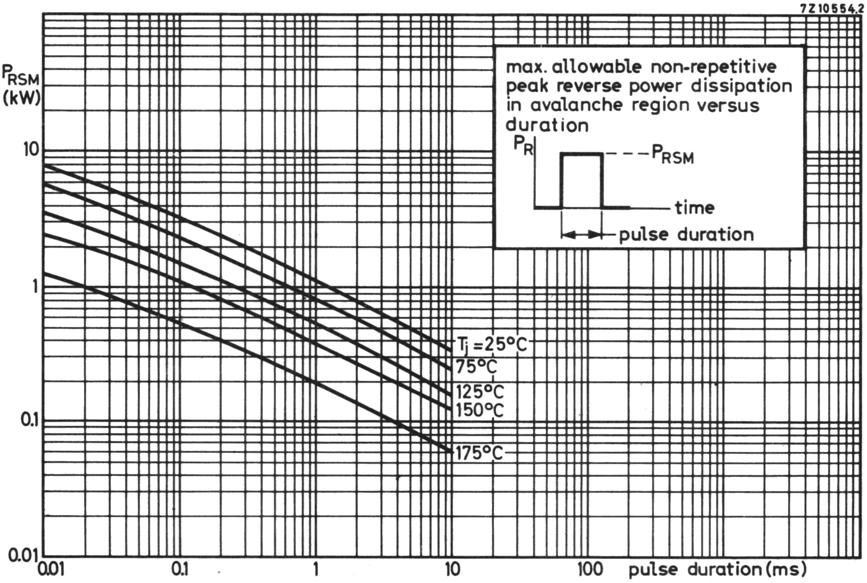
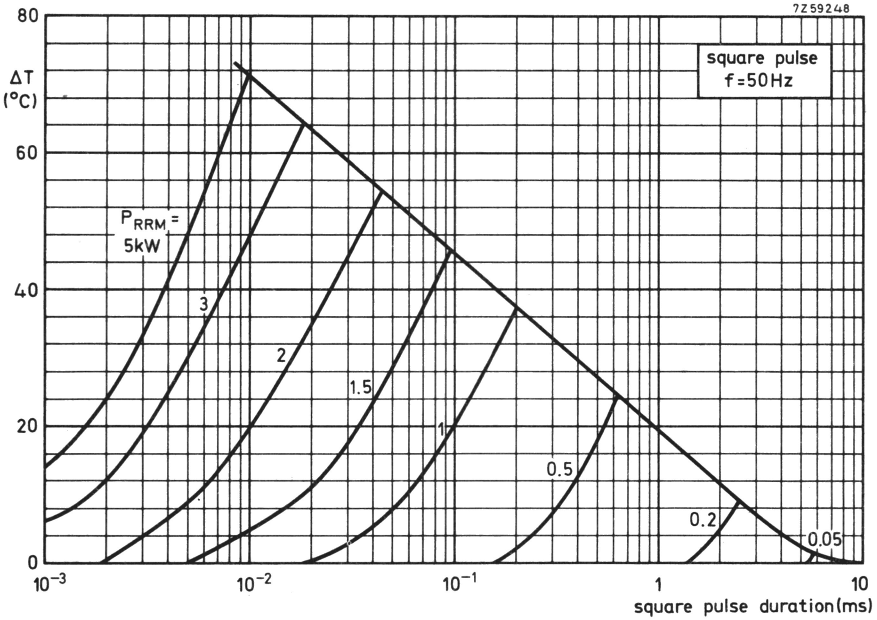
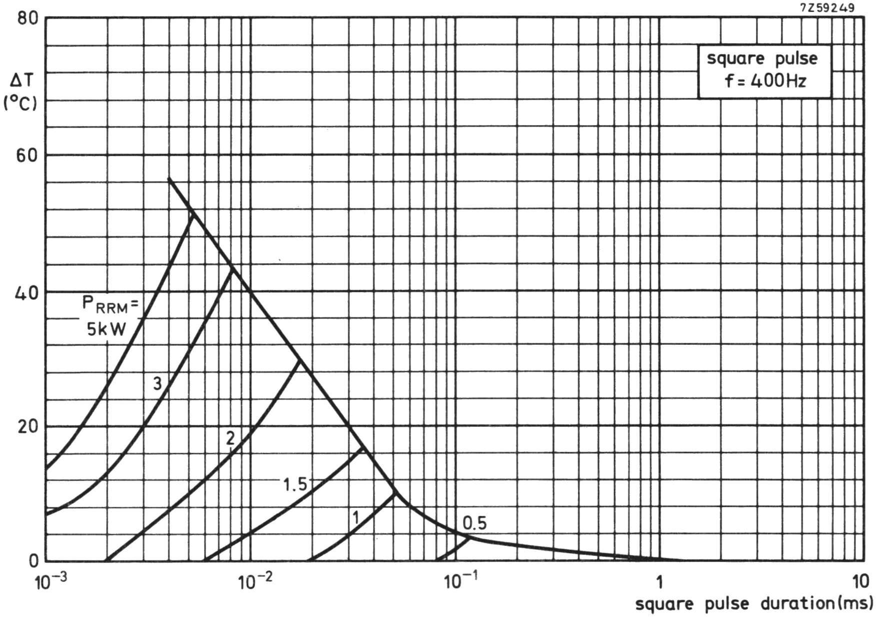
[1] Measured under pulsed conditions to avoid excessive dissipation.

[2] The avalanche breakdown voltage increases by about 0.1%/°C with increasing junction temperature.

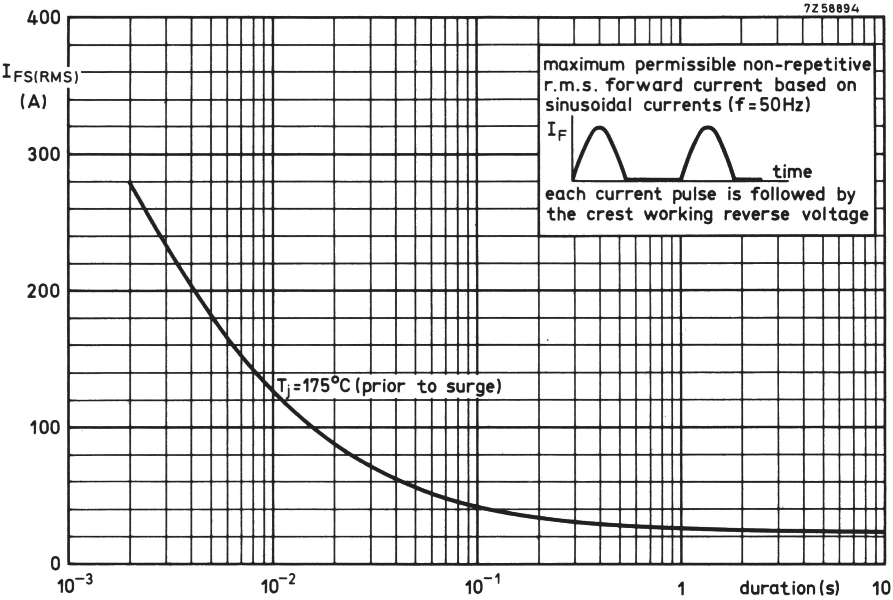

7Z59117
P=power excluding avalanche losses
single phase : a = 1.6
3-phase : a = 1.75
6-phase : a = 2.4
a = I_F(RMS) / I_F(AV)
interrelation between the power (derived from the left hand graph) and the max. allowable temperatures
P (W)
30
20
10
0
0
5
10
15
20
I_F(AV) (A)
1.6
d.c.
1.75
a = 2.4
0
50
100
150
200
T_amb (°C)
R_th mb-a = 0.5°C/W
2
4
6
8
10
15
T_mb (°C)
131
153
175

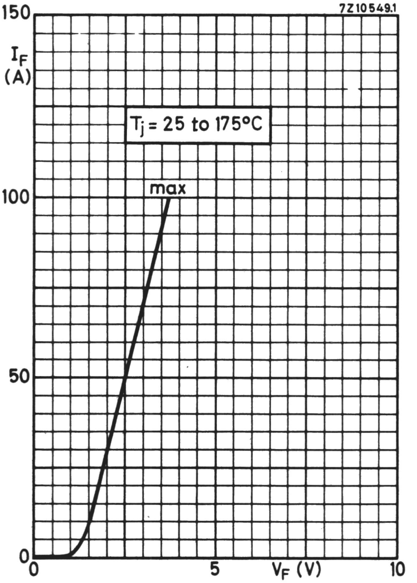

7Z10554.2
max. allowable non-repetitive peak reverse power dissipation in avalanche region versus duration
P_R
P_RSM
time
pulse duration
P_RSM (kW)
10
1
0.1
0.01
0.01
0.1
1
10
100
pulse duration (ms)
T_j = 25°C
75°C
125°C
150°C
175°C





ΔT = neccessary derating of $T_{j\,max}$ to accommodate repetitive transients in the reverse direction. Allowance can be made for this by assuming the ambient temperature ΔT higher.


7Z58894
$I_{FS(RMS)}$
(A)
400
300
200
100
0
10^{-3}
10^{-2}
10^{-1}
1
duration (s)
10
T_j = 175°C (prior to surge)
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50Hz)
I_F
time
each current pulse is followed by the crest working reverse voltage


7Z10549.1
150
I_F
(A)
100
50
0
T_j = 25 to 175°C
max
0
5
V_F (V)
10

SILICON RECTIFIER DIODES

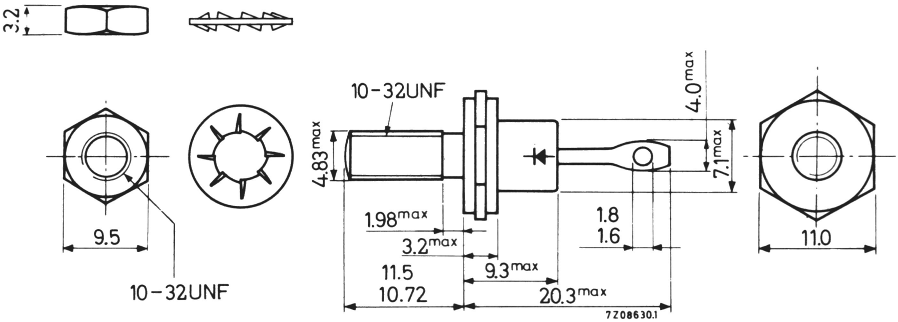
Diffused silicon rectifier diodes in a DO-4 metal envelope intended for power rectifier applications. The series consists of the following types.
Normal polarity (cathode to stud): BYX42-300 to 1200.
Reverse polarity (anode to stud): BYX42-300R to 1200R.

QUICK REFERENCE DATA

			BYX42-300(R)	600(R)	900(R)	1200(R)	
Crest working reverse voltage	V_{RWM}	max.	200	400	600	800	V
Repetitive peak reverse voltage	V_{RRM}	max.	300	600	900	1200	V
Average forward current up to T_{mb} = 130 °C	$I_{F(AV)}$	max.	10				A
Non-repetitive peak forward current t = 10 ms; T_j = 175 °C prior to surge	I_{FSM}	max.	125				A
Junction temperature	T_j	max.	175				°C

MECHANICAL DATA Dimensions in mm

DO-4



Net weight: 6.5 g
Diameter of clearance hole: max. 5.2 mm
Accessories supplied on request:
56295 (56262A)

Torque on nut: min. 8 kg cm
(0.8 Newton-metres)
max. 17 kg cm
(1.7 Newton-metres)
The mark shown applies to normal polarity types

All information applies to frequencies up to 400 Hz

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages			BYX42-300(R)	600(R)	900(R)	1200(R)	
Crest working reverse voltage	V_{RWM}	max.	200	400	600	800	V
Repetitive peak reverse voltage ($\delta \leq 0.01$)	V_{RRM}	max.	300	600	900	1200	V
Non-repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	300	600	900	1200	V

Currents

Average forward current (averaged over any 20 ms period) up to T_{mb} = 130 °C	$I_{F(AV)}$	max.	10	A
Forward current (d.c.)	I_F	max.	16	A
Repetitive peak forward current	I_{FRM}	max.	60	A
Non-repetitive peak forward current ($t = 10$ ms; half sine wave) T_j=125 °C prior to surge	I_{FSM}	max.	125	A

Temperatures

Storage temperature	T_{stg}		−55 to +175	°C
Junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	50	°C/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	3.0	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.5	°C/W

CHARACTERISTICS

Forward voltage at $I_F = 15$ A; $T_j = 25$ to 175 °C	V_F	<	1.4	V [1]
Peak reverse current at $V_{RM} = V_{RWMmax}$; $T_j = 125$ °C	I_{RM}	<	200	μA

OPERATING NOTES

1. When there is a possibility that transient voltages, caused by the stored energy in the transformer core, will exceed the maximum permissible non-repetitive peak reverse voltage, a damping circuit across the transformer should be applied. Either a series RC circuit or a voltage dependent resistor may be used. Suitable component values for an RC circuit across the transformer primary or secondary may be calculated as follows:

---

[1] Measured under pulsed conditions to avoid excessive dissipation.

OPERATING NOTES (continued)

$\frac{V_{RSM}}{V_{RWM}}$	RC across primary of transformer		RC across secondary of transformer	
	C (μF)	R (Ω)	C (μF)	R (Ω)
2.0	$200\frac{I_{mag}}{V_1}$	$\frac{150}{C}$	$225\frac{I_{mag}T^2}{V_1}$	$\frac{200}{C}$
1.5	$400\frac{I_{mag}}{V_1}$	$\frac{225}{C}$	$450\frac{I_{mag}T^2}{V_1}$	$\frac{275}{C}$

where I_{mag} = magnetising primary r.m.s. current (A)

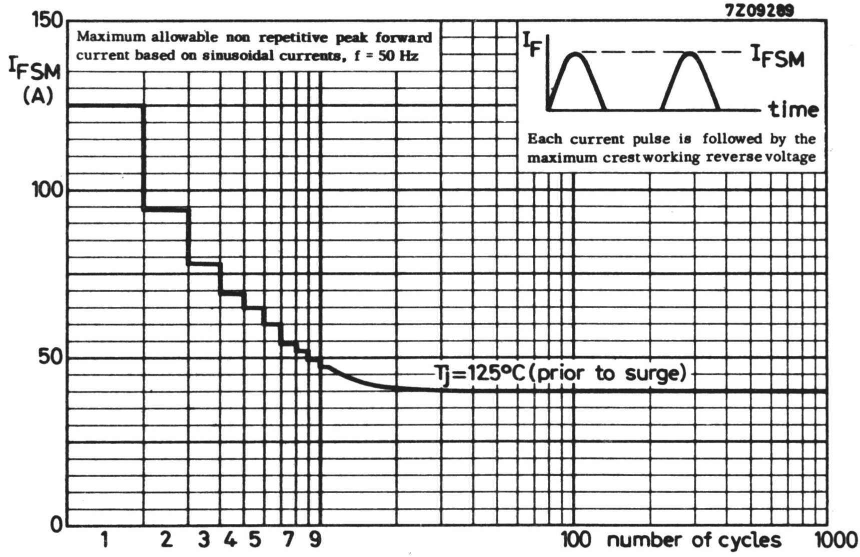
V_1 = transformer primary r.m.s. voltage

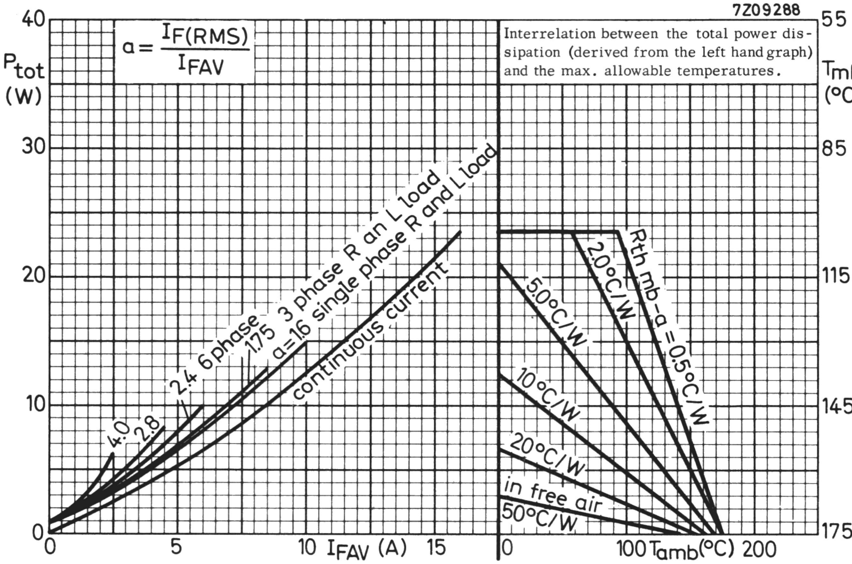
V_2 = transformer secondary r.m.s. voltage (V)

T = V_1/V_2

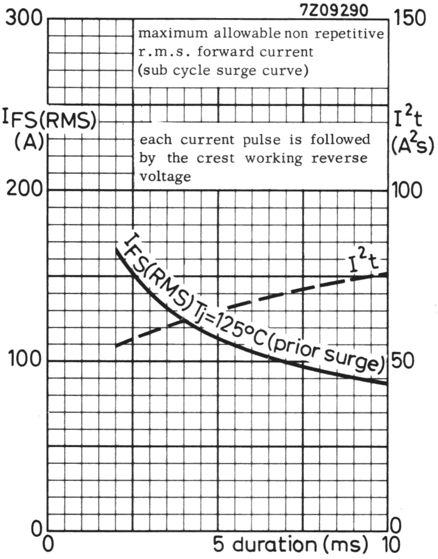
V_{RWM} stands for the actually applied crest working reverse voltage

2. In order to prevent the diodes from being damaged by surge currents higher than those mentioned in the curve on page 4 a fast fuse is recommended.
3. The top connector should neither be bent nor twisted; it should be soldered into the circuit so there is no strain on it.
   During soldering the heat conduction to the junction should be kept to a minimum by using a thermal shunt.



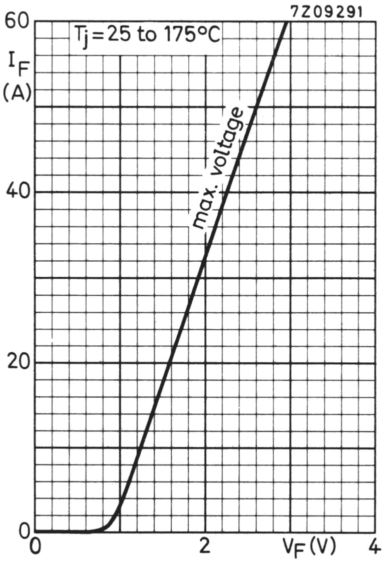


Interrelation between the total power dissipation (derived from the left hand graph) and the max. allowable temperatures.



maximum allowable non repetitive r.m.s. forward current (sub cycle surge curve)

each current pulse is followed by the crest working reverse voltage



CONTROLLED AVALANCHE RECTIFIER DIODES

Diffused silicon diodes in a DO-1 metal envelope, capable of absorbing transients. They are intended for rectifier applications and particularly suited for series operation.

The series consists of the following reverse polarity types (anode to case): BYX45-600R, BYX45-800R, BYX45-1000R.

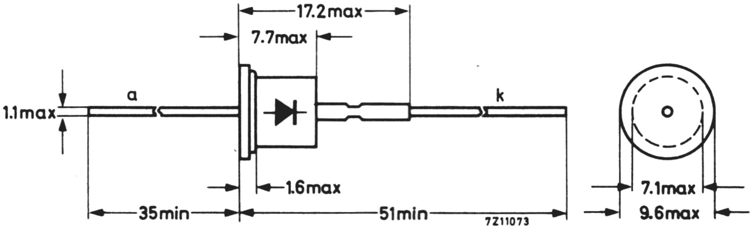
QUICK REFERENCE DATA

			BYX45-600R	800R	1000R	
Crest working reverse voltage	V_{RWM}	max.	600	800	1000	V
Reverse breakdown voltage	$V_{(BR)R}$	>	750	1000	1250	V
Average forward current	I_{FAV}	max.	1.5			A
Non repetitive peak forward current t = 10 ms; T_j = 150 °C (prior to surge)	I_{FSM}	max.	40			A
Non repetitive peak reverse power t = 10 μs; T_j = 25 °C	P_{RSM}	max.	2.5			kW
Junction temperature	T_j	max.	150			°C

MECHANICAL DATA

Dimensions in mm

DO-1



All information applies to frequencies up to 400 Hz

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

			BYX45-600R	800R	1000R	
Crest working reverse voltage	V_{RWM}	max.	600	800	1000	V

Currents

Average forward current (averaged over any 20 ms period) (see also **page 5**)	I_{FAV}	max.	1.5	A
Forward current (d.c.)	I_F	max.	2.0	A
R.M.S. forward current	$I_{F(RMS)}$	max.	2.4	A
Repetitive peak forward current	I_{FRM}	max.	15	A
Non repetitive peak forward current t = 10 ms; T_j = 150 °C (prior to surge)	I_{FSM}	max.	40	A
I squared t for fusing (t = 10 ms)	I^2t	max.	8	A^2s

Reverse power dissipation

Repetitive peak reverse power dissipation (square wave) f = 50 Hz; t = 10 μs; T_j = 125 °C	P_{RRM}	max.	800	W
Non repetitive peak reverse power dissipation (square wave) t = 10 μs; T_j = 25 °C (prior to surge)	P_{RSM}	max.	2.5	kW
t = 10 μs; T_j = 150 °C (prior to surge)	P_{RSM}	max.	800	W

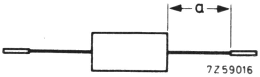
Temperatures

Storage temperature	T_{stg}		−55 to +150	°C
Junction temperature	T_j	max.	150	°C

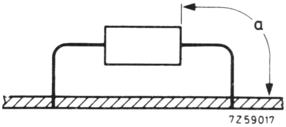
THERMAL RESISTANCE

Effect of mounting on thermal resistance $R_{th\ j-a}$

The quoted values apply when no other leads run to the tie–points. If leads of other dissipating components share the same tie–points, the thermal resistance will be higher than that quoted.



1. Mounted to solder tags at a lead-length a = 10 mm. $R_{th\ j-a}$ = 60 °C/W
2. Mounted to solder tags at a = maximum lead-length. $R_{th\ j-a}$ = 70 °C/W



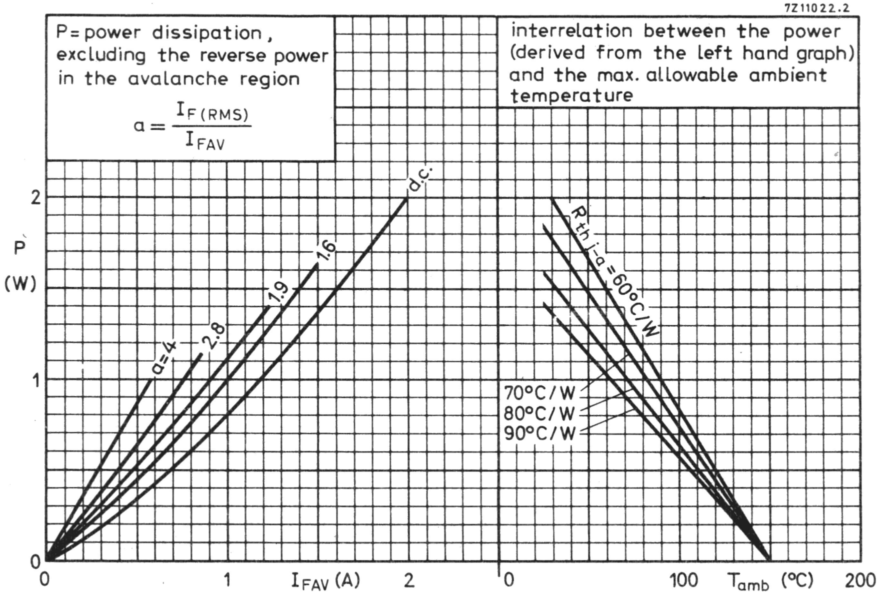
3. Mounted on printed-wiring board at a = maximum lead-length. $R_{th\ j-a}$ = 80 °C/W
4. Mounted on printed-wiring board at a lead-length a = 10 mm. $R_{th\ j-a}$ = 90 °C/W

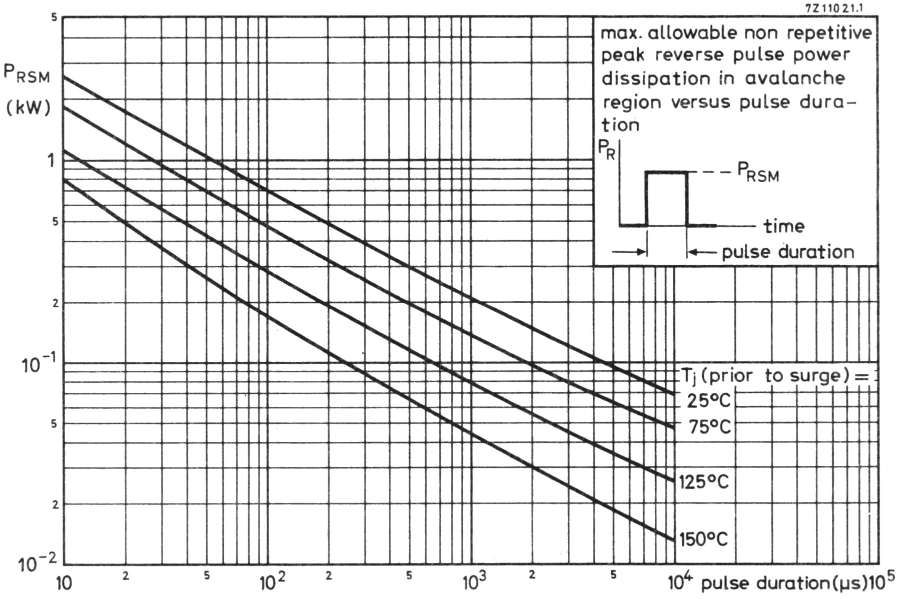
SOLDERING AND MOUNTING NOTES

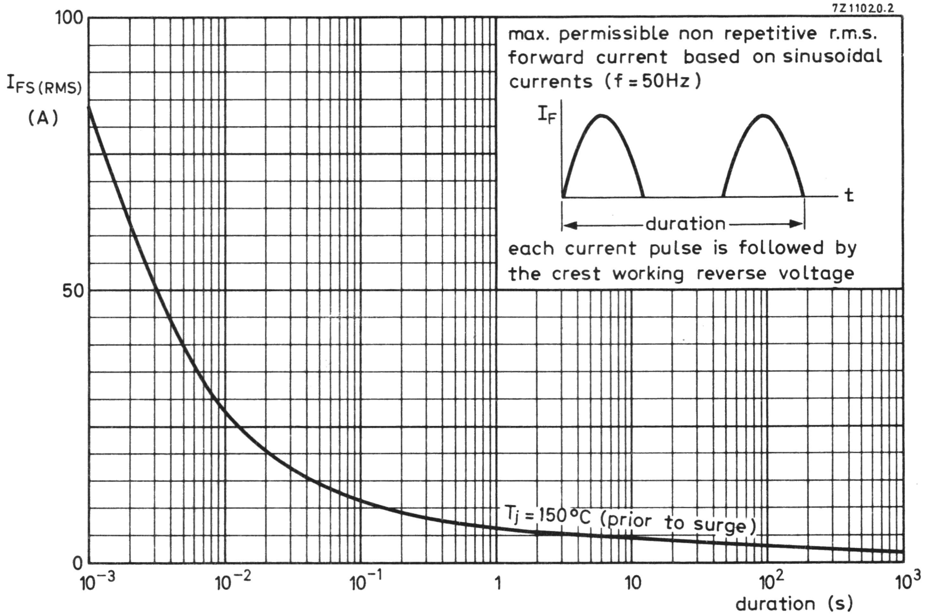
1. At a soldering iron or bath temperature of up to 245 °C, the maximum permissible soldering time is 10 s if the joint is 5 mm from the seal, 3 s if it is 1.5 mm from the seal.
2. At a temperature between 245 °C and 400 °C (max.), the joint must be more than 5 mm from the seal and soldering time must not exceed 5 s.
3. Leads should not be bent less than 1.5 mm from the seal; excert no axial pull when bending.

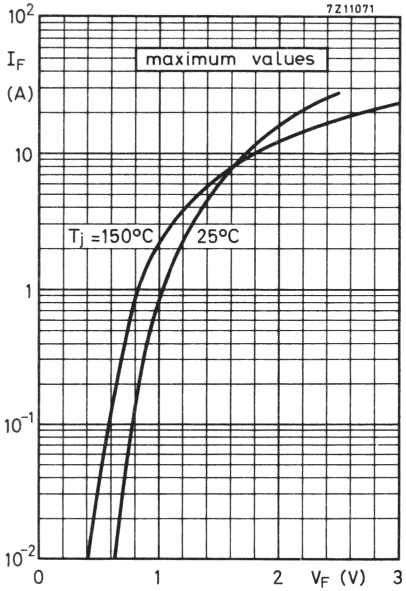
CHARACTERISTICS

Voltages			BYX45-600R	800R	1000R	
Forward voltage at I_F = 5 A; T_j = 25 °C	V_F	<	1.45	1.45	1.45	V
Reverse avalanche breakdown voltage I_R = 1 mA; T_j = 25 °C	$V_{(BR)R}$	>	750	1000	1250	V
		<	2000	2000	2000	V
Current						
Peak reverse current at T_j = 125 °C $V_R = V_{RWMmax}$	I_{RM}	<	100	100	100	μA


7Z11022.2
P = power dissipation, excluding the reverse power in the avalanche region
$a = \frac{I_{F(RMS)}}{I_{FAV}}$
interrelation between the power (derived from the left hand graph) and the max. allowable ambient temperature
P
(W)
2
1
0
0
1
I_{FAV} (A)
2
a=4
2.8
1.9
1.6
d.c.
$R_{th\ j-a}$ = 60°C/W
70°C/W
80°C/W
90°C/W
0
100
T_{amb} (°C)
200


7Z11021.1
max. allowable non repetitive peak reverse pulse power dissipation in avalanche region versus pulse duration
P_R
P_{RSM}
time
pulse duration
P_{RSM}
(kW)
5
1
5
2
10^{-1}
5
2
10^{-2}
10
2
5
10^2
2
5
10^3
2
5
10^4
pulse duration (μs)
10^5
T_j (prior to surge) =
25°C
75°C
125°C
150°C


7Z11020.2
100
$I_{FS(RMS)}$
(A)
50
0
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
10^3
duration (s)
max. permissible non repetitive r.m.s. forward current based on sinusoidal currents (f = 50Hz)
I_F
t
duration
each current pulse is followed by the crest working reverse voltage
T_j = 150 °C (prior to surge)


7Z11071
10^2
I_F
(A)
10
1
10^{-1}
10^{-2}
maximum values
T_j =150°C
25°C
0
1
2
V_F (V)
3

FAST RECOVERY RECTIFIER DIODES WITH CONTROLLED AVALANCHE

Diffused silicon diodes in a DO-4 metal envelope, capable of absorbing transients. They are primarily intended for use in high frequency power supplies, thyristor inverters and multi-phase power rectifier applications. The series consists of the following types: Normal polarity (cathode to stud): BYX46-200 to BYX46 -600
Reverse polarity (anode to stud): BYX46-200R to BYX46-600(R)

QUICK REFERENCE DATA

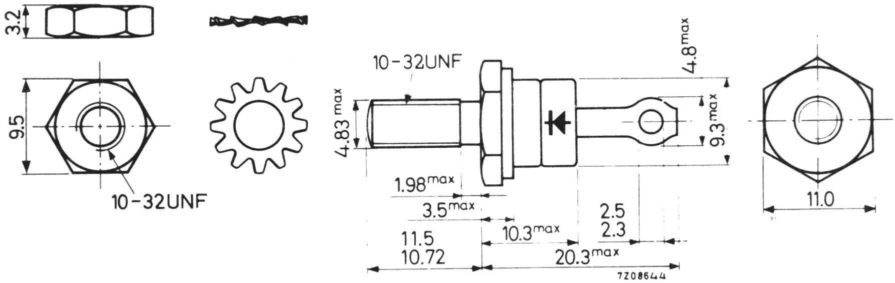
			BYX46-200(R)	300(R)	400(R)	500(R)	600(R)	
Crest working reverse voltage	V_{RWM}	max.	200	300	400	500	600	V
Reverse avalanche breakdown voltage	$V_{(BR)R}$	>	250	375	500	625	750	V

Average forward current up to $T_{mb} = 100\,^{o}C$	$I_{F(AV)}$	max.	22	A
at $T_{mb} = 125\,^{o}C$	$I_{F(AV)}$	max.	15	A
Non-repetitive peak forward current; t = 10 ms $T_j = 165\,^{o}C$ prior to surge	I_{FSM}	max.	300	A
Junction temperature	T_j	max.	165	^{o}C
Reverse recovery time when switched from $I_F = 2\,A$ to $V_R = 30\,V$ I_R limited to $I_{RRM} = 2\,A$; $-dI/dt = 100\,A/\mu s$	t_{rr}	<	0.35	μs

MECHANICAL DATA

Dimensions in mm

DO-4



Net weight: 7.8 g
Diameter of clearance hole: max. 5.2 mm
Accessories supplied on request:
56295, (56262A)

Torque on nut: min. 9 kg cm
(0.9 Newton-metres)
max. 17 kg cm
(1.7 Newton-metres)
The mark shown applies to normal polarity types.

All information applies to frequencies up to 50 kHz

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltage			BYX46-200(R)	300(R)	400(R)	500(R)	600(R)	
Crest working reverse voltage	V_{RWM}	max.	200	300	400	500	600	V

Currents

Average forward current (averaged over any 20 ms period) up to T_{mb} = 100 °C	$I_{F(AV)}$	max.	22	A
at T_{mb} = 125 °C	$I_{F(AV)}$	max.	15	A
Forward current (d.c.)	I_F	max.	30	A
Repetitive peak forward current	I_{FRM}	max.	400	A
Non-repetitive peak forward current (t = 10 ms; half sine wave) T_j = 165 °C prior to surge	I_{FSM}	max.	300	A
Repetitive peak reverse current (during turn-off)	I_{RRM}	max.	25	A

Reverse power dissipation

Repetitive peak reverse power dissipation t = 10 μs (square wave; f = 50 Hz) T_j = 100 °C	P_{RRM}	max.	9.5	kW
Non-repetitive peak reverse power dissipation t = 10 μs (square wave) T_j = 25 °C prior to surge	P_{RSM}	max.	18	kW
T_j = 165 °C prior to surge	P_{RSM}	max.	4	kW

Temperatures

Storage temperature	T_{stg}	-55 to +165		°C
Junction temperature	T_j	max.	165	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	50	°C/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.3	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.5	°C/W

CHARACTERISTICS

			BYX46-200(R)	300(R)	400(R)	500(R)	600(R)	
Forward voltage								
$I_F = 50\,A$; $T_j = 25\,^oC$	V_F	<	2.0	2.0	2.0	2.0	2.0	V
Reverse avalanche breakdown voltage								
$I_R = 5\,mA$; $T_j = 25\,^oC$	$V_{(BR)R}$	>	250	375	500	625	750	V
		<	1050	1050	1050	1050	1050	V
Peak reverse current								
$V_{RM} = V_{RWMmax}$; $T_j = 125^oC$	I_{RM}	<	4.0	4.0	4.0	4.0	4.0	mA

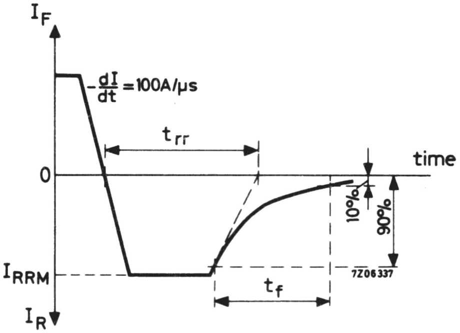
Reverse recovery charge when switched from

$I_F = 2\,A$ to $V_R = 30\,V$;
with $-\frac{dI}{dt} = 100\,A/\mu s$; $T_j = 25\,^oC$ $\qquad Q_s < 0.70\ \mu C$

Reverse recovery time when switched from

$I_F = 2\,A$ to $V_R = 30\,V$;
I_R limited to $I_{RRM} = 2\,A$; $-\frac{dI}{dt} = 100\,A/\mu s$; $T_j = 25\,^oC$ $\qquad t_{rr} < 0.35\ \mu s$

Fall time under all conditions $\qquad t_f < 0.30\ \mu s$



OPERATING NOTES FOR (See also general pages at the beginning of this section.)

1. Square wave operation
When I_F has been flowing sufficiently long for the steady state to be established, there will be a charge due to minority carriers present. Before the device can block in the reverse direction this charge must be extracted. This extraction takes the form of a reverse transient (see figure above). The majority of the power dissipation due to the reverse transient occurs during t_f as the rectifier gradually becomes reverse biased, and the mean power will be proportional to the operating frequency. The mean value of this power loss can be derived from the graphs on page 11)

p.t.o.

OPERATING NOTES (continued)

2. Sine wave operation

Power loss in sine wave operation will be considerably less owing to the much slower rate of change of the applied voltage (and consequently lower values of I_{RRM}), so that power loss due to reverse recovery may be safely ignored for frequencies up to 50 kHz.

3. Determination of the heatsink thermal resistance

Example:

Assume a diode, used in an inverter.

frequency	f	=	20	kHz
duty cycle	δ	=	0.5	
ambient temperature	T_{amb}	=	40	°C
switched from	I_F	=	12	A
to	V_R	=	300	V
at a rate	$-\frac{dI}{dt}$	=	50	A/µs

At a duty cycle $\delta = 0.5$ the average forward current $I_{FAV} = 6$ A.
From the upper graph on page 5 it follows, that at $I_{FAV} = 6$ A the average forward power + average leakage power = 13 W (point A).
The additional power losses due to switching-off can be read from the nomogram on page 10 (the example being based on optimum use, i.e. $T_j = 165$ °C). Starting from $I_F = 12$ A on the horizontal scale trace upwards until the appropriate line $-\frac{dI}{dt} = 50$ A/µs. From the intersection trace horizontally to the right until the line for f = 20 kHz. Then trace downwards to the line $V_R = 300$ V and ultimately trace horizontally to the left and on the vertical axis read the additional average power dissipation $P_{RAV} = 6$ W.
Therefore the total power dissipation $P_{tot} = 13 \text{ W} + 6 \text{ W} = 19 \text{ W}$ (point B of the upper graph on page 5).

From the right hand part of the upper graph on page 5 follows the thermal resistance, required at $T_{amb} = 40$ °C.

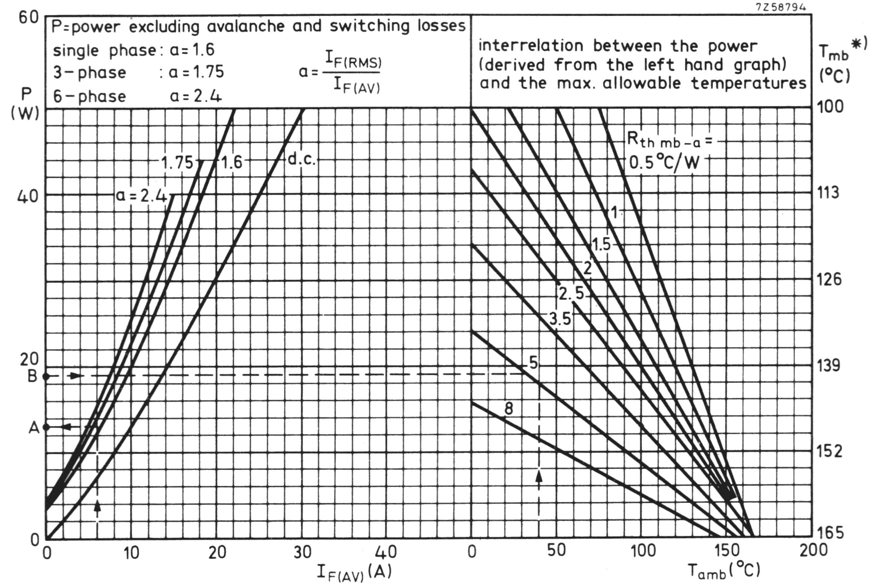
$$R_{th\ mb-a} \approx 5\ ^{o}C/W$$

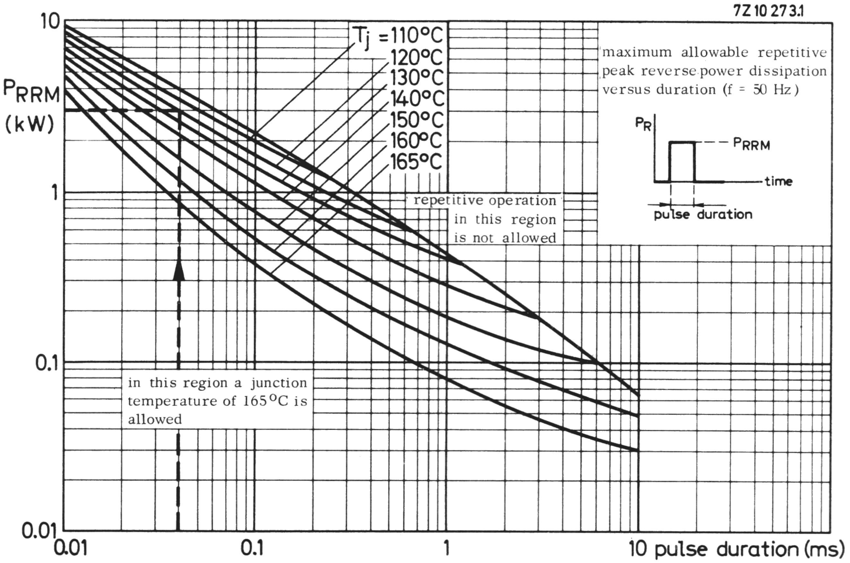
The contact thermal resistance $R_{th\ mb-h} = 0.5\ ^{o}C/W$.

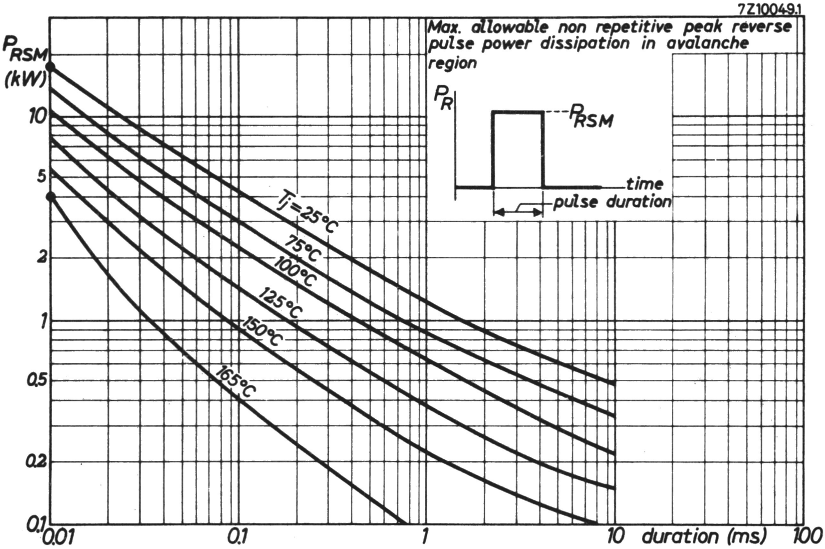
Hence the heatsink thermal resistance should be:

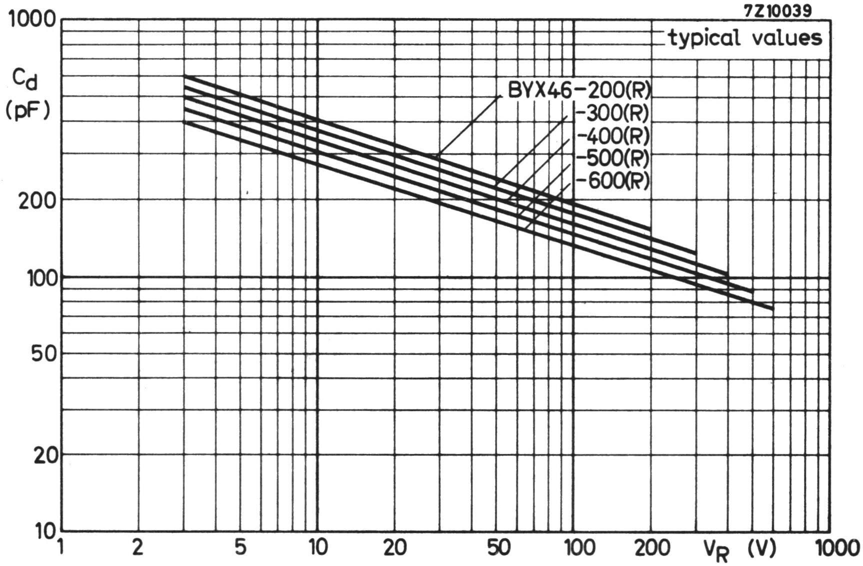
$$R_{th\ h-a} = R_{th\ mb-a} - R_{th\ mb-h} = (5 - 0.5)\ ^{o}C/W = 4.5\ ^{o}C/W.$$

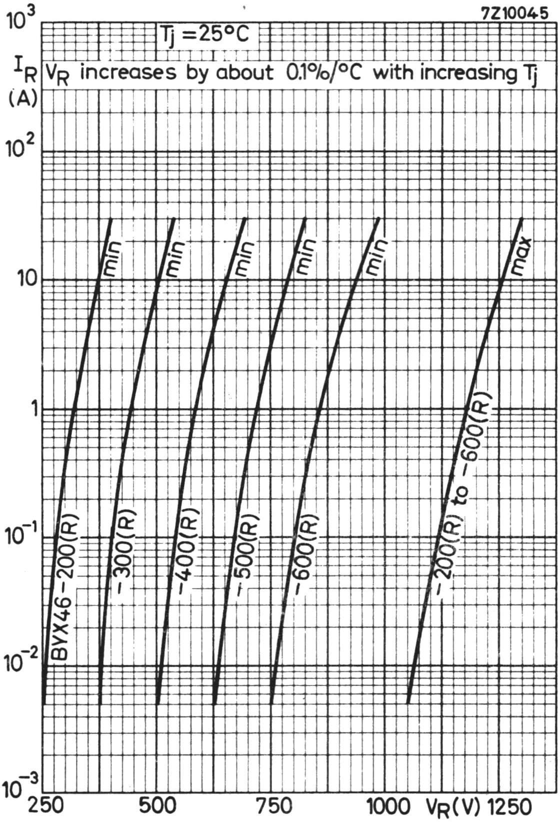
The applicable heatsink(s) may then be found in the Section HEATSINKS.

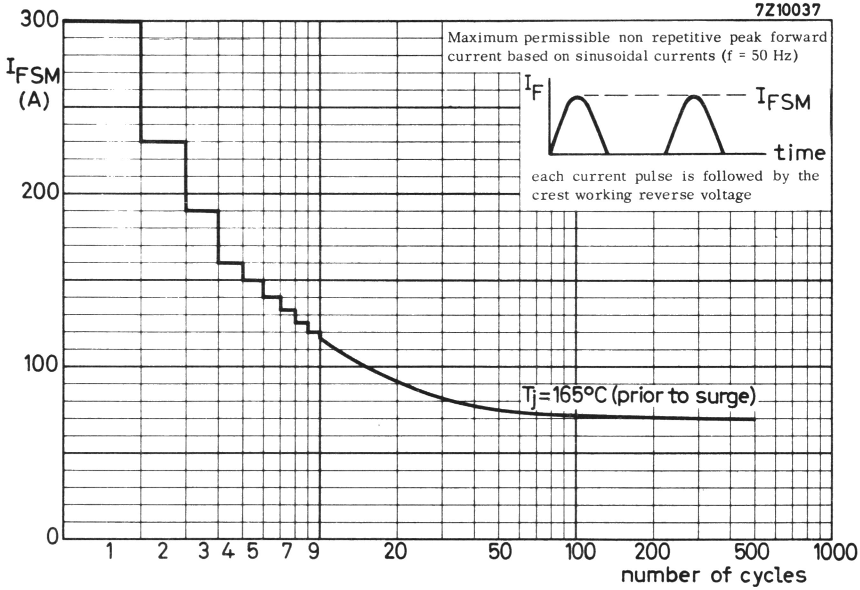

7Z58794
P=power excluding avalanche and switching losses
single phase: a = 1.6
3-phase : a = 1.75
6-phase a = 2.4
a = I_F(RMS) / I_F(AV)
interrelation between the power (derived from the left hand graph) and the max. allowable temperatures
P (W)
60
40
20
B
A
0
a = 2.4
1.75
1.6
d.c.
0
10
20
30
40
I_F(AV) (A)
R_th mb-a = 0.5°C/W
1
1.5
2
2.5
3.5
5
8
0
50
100
150
200
T_amb (°C)
T_mb *) (°C)
100
113
126
139
152
165


7Z10273.1
P_RRM (kW)
10
1
0.1
0.01
T_j = 110°C
120°C
130°C
140°C
150°C
160°C
165°C
repetitive operation in this region is not allowed
in this region a junction temperature of 165°C is allowed
maximum allowable repetitive peak reverse power dissipation versus duration (f = 50 Hz)
P_R
P_RRM
time
pulse duration
0.01
0.1
1
10 pulse duration (ms)


7Z10049.1
Max. allowable non repetitive peak reverse pulse power dissipation in avalanche region
P_{RSM} (kW)
P_R
P_{RSM}
time
pulse duration
T_j=25°C
75°C
100°C
125°C
150°C
165°C
10
5
2
1
0.5
0.2
0.1
0.01
0.1
1
10
duration (ms)
100

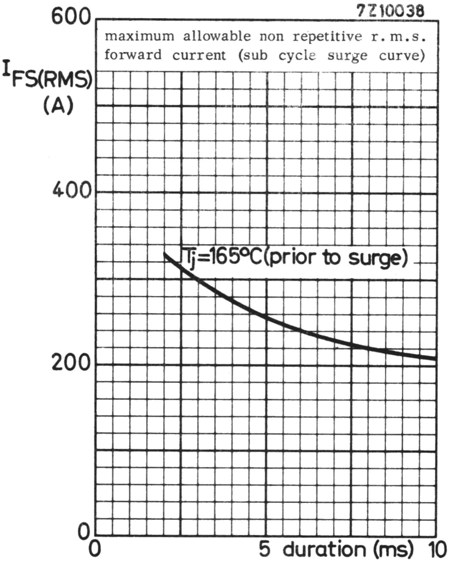

7Z10039
typical values
C_d (pF)
BYX46-200(R)
-300(R)
-400(R)
-500(R)
-600(R)
1000
200
100
50
20
10
1
2
5
10
20
50
100
200
V_R (V)
1000


7Z10045
Tj = 25°C
I_R (A)
V_R increases by about 0.1%/°C with increasing Tj
10^3
10^2
10
1
10^{-1}
10^{-2}
10^{-3}
250
500
750
1000
V_R(V)
1250
min
min
min
min
min
max
BYX46−200(R)
−300(R)
−400(R)
−500(R)
−600(R)
−200(R) to −600(R)

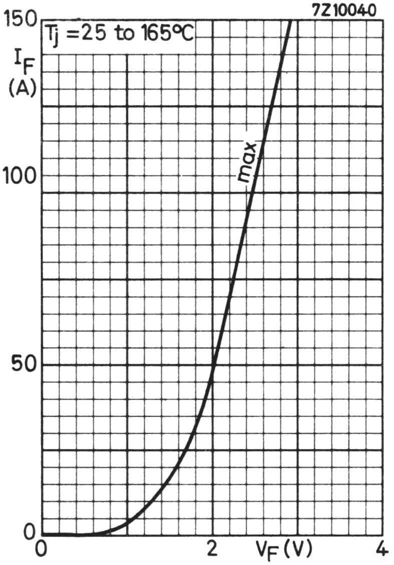


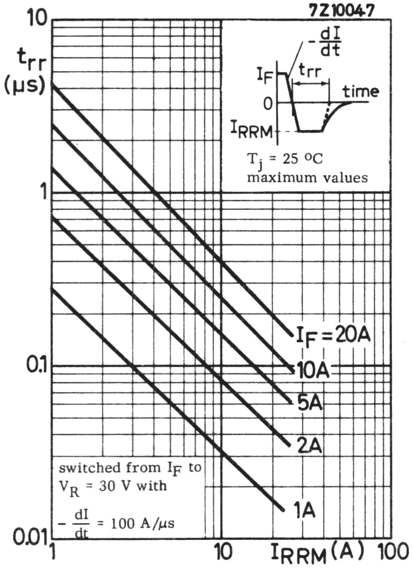
Maximum permissible non repetitive peak forward current based on sinusoidal currents (f = 50 Hz)

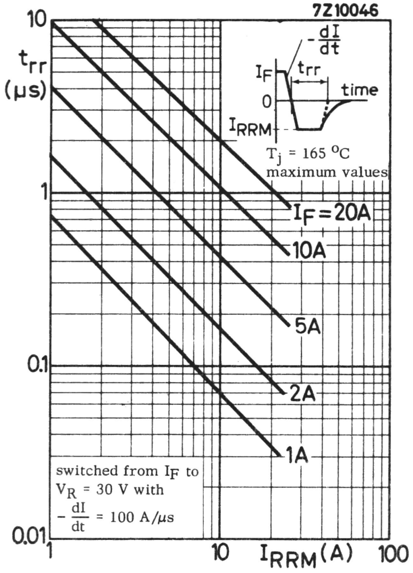
each current pulse is followed by the crest working reverse voltage

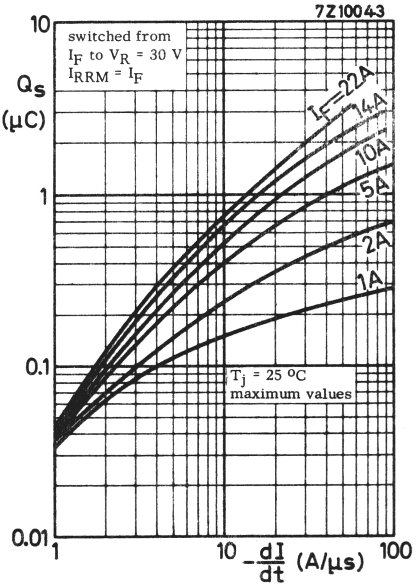


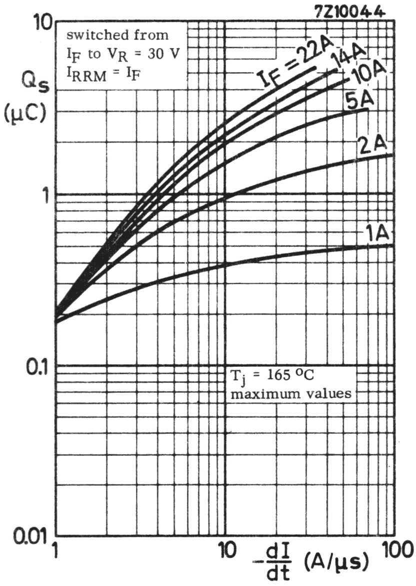
maximum allowable non repetitive r.m.s. forward current (sub cycle surge curve)

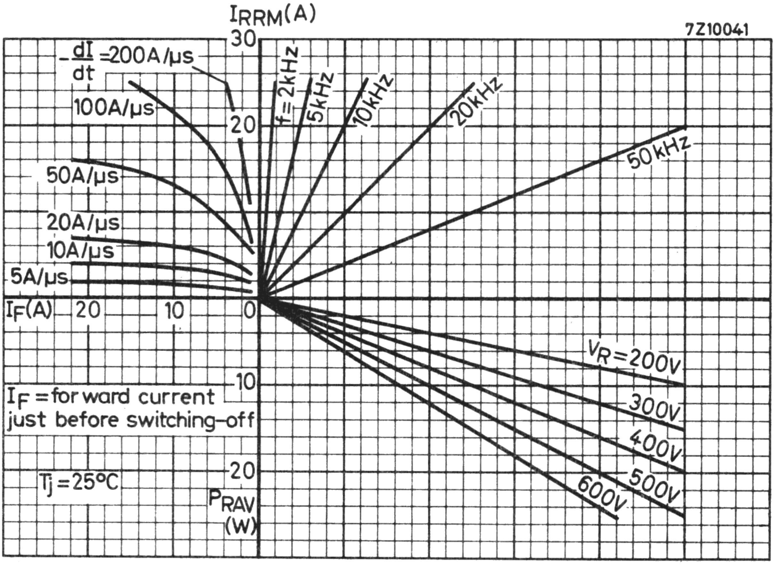


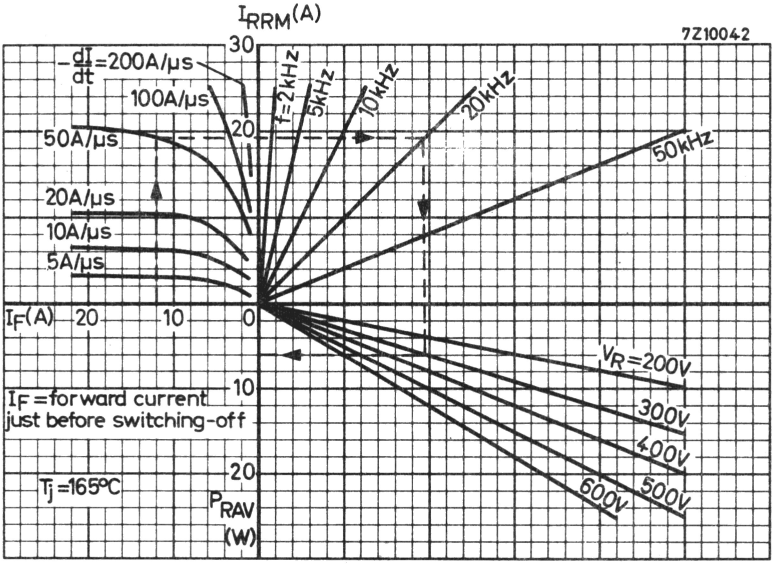

7Z10047
10
t_{rr}
(μs)
1
0.1
0.01
1
10
I_{RRM} (A)
100
$-\frac{dI}{dt}$
I_F
t_{rr}
time
0
I_{RRM}
T_j = 25 °C
maximum values
I_F = 20A
10A
5A
2A
1A
switched from I_F to
V_R = 30 V with
$-\frac{dI}{dt}$ = 100 A/μs


7Z10046
10
t_{rr}
(μs)
1
0.1
0.01
1
10
I_{RRM} (A)
100
$-\frac{dI}{dt}$
I_F
t_{rr}
time
0
I_{RRM}
T_j = 165 °C
maximum values
I_F = 20A
10A
5A
2A
1A
switched from I_F to
V_R = 30 V with
$-\frac{dI}{dt}$ = 100 A/μs


7Z10043
10
Q_s
(μC)
1
0.1
0.01
1
10
$-\frac{dI}{dt}$ (A/μs)
100
switched from
I_F to V_R = 30 V
I_{RRM} = I_F
I_F = 22A
14A
10A
5A
2A
1A
T_j = 25 °C
maximum values


7Z10044
10
Q_s
(μC)
1
0.1
0.01
1
10
$-\frac{dI}{dt}$ (A/μs)
100
switched from
I_F to V_R = 30 V
I_{RRM} = I_F
I_F = 22A
14A
10A
5A
2A
1A
T_j = 165 °C
maximum values





Nomogram: Power loss P_{RAV} due to switching only (square wave operation)

SILICON RECTIFIER DIODES

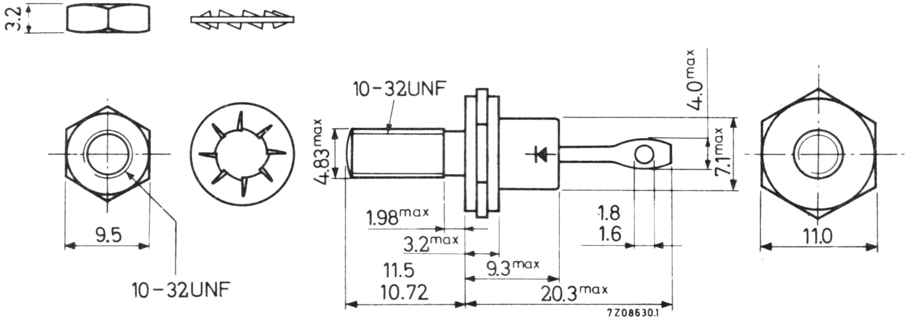
Diffused silicon rectifier diodes in a DO-4 metal envelope intended for power rectifier applications. The series consists of the following types.
Normal polarity (cathode to stud): BYX48-300 to BYX48-1200
Reverse polarity (anode to stud): BYX48-300R to BYX48-1200R

QUICK REFERENCE DATA

			BYX48-300(R)	600(R)	900(R)	1200(R)	
Crest working reverse voltage	V_{RWM}	max.	200	400	600	800	V
Repetitive peak reverse voltage	V_{RRM}	max.	300	600	900	1200	V
Average forward current up to T_{mb} = 130 °C	$I_{F(AV)}$	max.	6.0				A
Non-repetitive peak forward current $t = 10$ ms; $T_j = 175$ °C prior to surge	I_{FSM}	max.	90				A
Junction temperature	T_j	max.	175				°C

MECHANICAL DATA Dimensions in mm

DO-4



Net weight: 6.5 g
Diameter of clearance hole: max. 5.2 mm
Accessories supplied on request:
56295 (56262A)

Torque on nut: min. 8 kg cm
(0.8 Newton-metres)
max. 17 kg cm
(1.7 Newton-metres)
The mark shown applies to normal polarity types

All information applies to frequencies up to 400 Hz

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages			BYX48-300(R)	600(R)	900(R)	1200(R)	
Crest working reverse voltage	V_{RWM}	max.	200	400	600	800	V
Repetitive peak reverse voltage ($\delta \leq 0.01$)	V_{RRM}	max.	300	600	900	1200	V
Non-repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	300	600	900	1200	V

Currents

Average forward current (averaged over any 20 ms period) up to $T_{mb} = 130\,^{o}C$	$I_{F(AV)}$	max.	6.0	A
Forward current (d.c.)	I_F	max.	9.5	A
Repetitive peak forward current	I_{FRM}	max.	36	A
Non-repetitive peak forward current ($t = 10$ ms; half sine wave) $T_j = 175\,^{o}C$ prior to surge	I_{FSM}	max.	90	A

Temperatures

Storage temperature	T_{stg}		−55 to +175	^{o}C
Junction temperature	T_j	max.	175	^{o}C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\,j\text{-}a}$	=	50	$^{o}C/W$
From junction to mounting base	$R_{th\,j\text{-}mb}$	=	4.5	$^{o}C/W$
From mounting base to heatsink	$R_{th\,mb\text{-}h}$	=	0.5	$^{o}C/W$

CHARACTERISTICS

Forward voltage at $I_F = 15$ A; $T_j = 25$ to $175\,^{o}C$	V_F	<	1.8	V [1]
Peak reverse current at $V_{RM} = V_{RWMmax}$; $T_j = 125\,^{o}C$	I_{RM}	<	200	μA

OPERATING NOTES

1. When there is a possibility that transient voltages, caused by the stored energy in the transformer core, will exceed the maximum permissible non repetitive peak reverse voltage, a damping circuit across the transformer should be applied. Either a series RC circuit or a voltage dependent resistor may be used. Suitable component values for an RC circuit across the transformer primary or secondary may be calculated as follows:

---

1) Measured under pulsed conditions to avoid excessive dissipation.

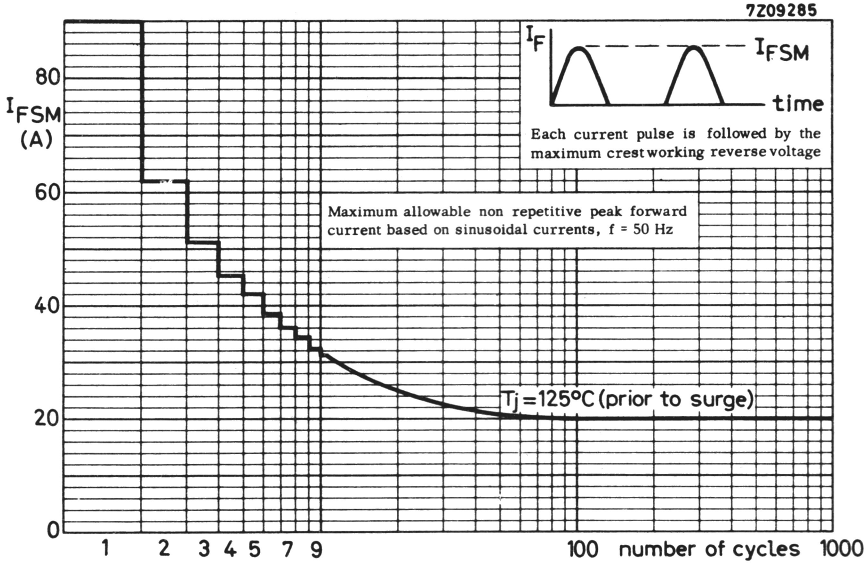
OPERATING NOTES (continued)

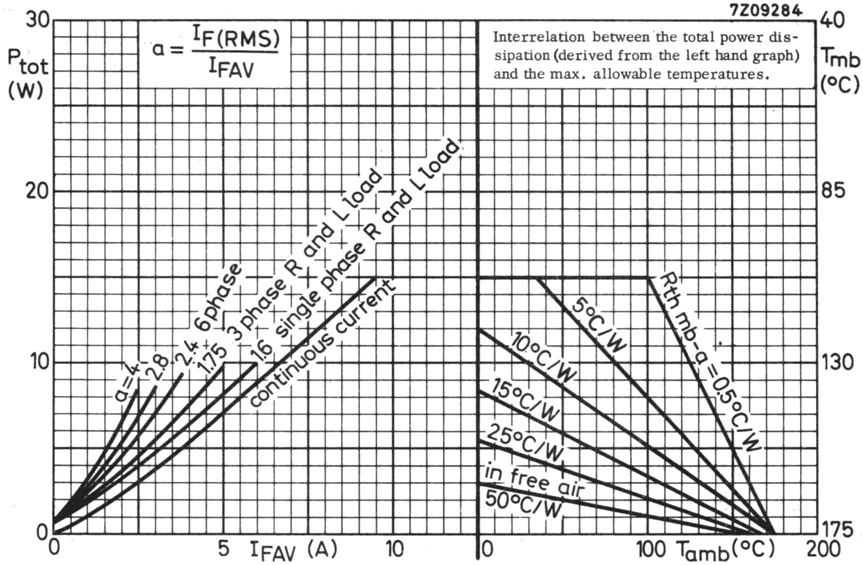
$\frac{V_{RSM}}{V_{RWM}}$	RC across primary of transformer		RC across secondary of transformer	
	C (μF)	R (Ω)	C (μF)	R (Ω)
2.0	$200\frac{I_{mag}}{V_1}$	$\frac{150}{C}$	$225\frac{I_{mag}T^2}{V_1}$	$\frac{200}{C}$
1.5	$400\frac{I_{mag}}{V_1}$	$\frac{225}{C}$	$450\frac{I_{mag}T^2}{V_1}$	$\frac{275}{C}$

where I_{mag} = magnetising primary r.m.s. current (A)
V_1 = transformer primary r.m.s. voltage (V)
V_2 = transformer secondary r.m.s. voltage (V)
T = V_1/V_2
V_{RWM} stands for the actually applied crest working reverse voltage

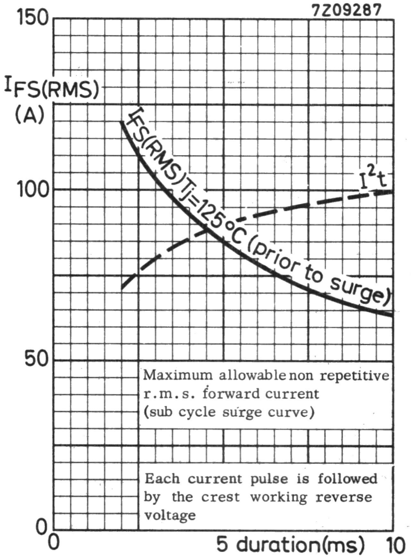
2. In order to prevent the diodes from being damaged by surge currents higher than those mentioned in the curves on page 4 a fast fuse is recommended.

3. The top connector should neither be bent nor twisted; it should be soldered into the circuit so there is no strain on it.
During soldering the heat conduction to the junction should be kept to a minimum by using a thermal shunt.



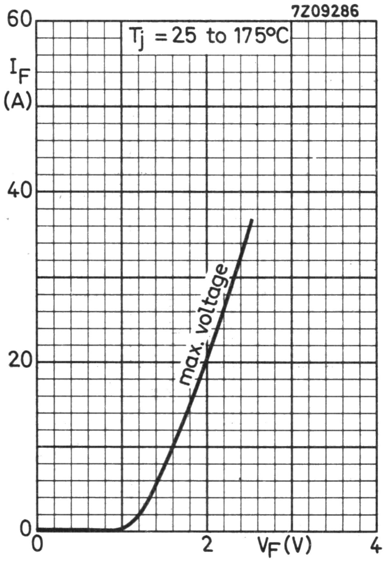


Interrelation between the total power dissipation (derived from the left hand graph) and the max. allowable temperatures.



Maximum allowable non repetitive r.m.s. forward current (sub cycle surge curve)

Each current pulse is followed by the crest working reverse voltage



FAST RECOVERY RECTIFIER DIODES

Diffused silicon diodes in a DO-4 metal envelope, intended for use in high frequency power supplies, thyristor inverters and multi-phase power rectifier applications.
The series consists of the following types:
Normal polarity (cathode to stud): BYX50-200 to BYX50-600
Reverse polarity (anode to stud): BYX50-200R to BYX50-600R.

QUICK REFERENCE DATA

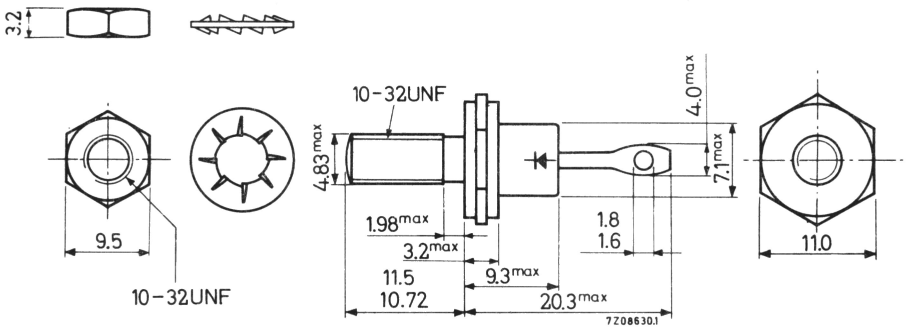
			BYX50-200(R)	300(R)	400(R)	500(R)	600(R)
Crest working reverse voltage	V_{RWM}	max.	200	300	400	500	600
Repetitive peak reverse voltage	V_{RRM}	max.	200	300	400	500	600

Average forward current up to T_{mb} = 110 °C	$I_{F(AV)}$	max.	6	A
at T_{mb} = 125 °C	$I_{F(AV)}$	max.	4	A
Non-repetitive peak forward current t = 10 ms; T_j = 150 °C (prior to surge)	I_{FSM}	max.	80	A
Junction temperature	T_j	max.	150	°C
Reverse recovery time when switched form I_F = 4 A to V_R = 30 V $-dI/dt$ = 4 A/μs	t_{rr}	<	500	ns

MECHANICAL DATA see page 2

MECHANICAL DATA Dimensions in mm

DO-4


3.2
10-32UNF
4.83 max
4.0 max
7.1 max
9.5
10-32UNF
1.98 max
3.2 max
11.5
10.72
9.3 max
20.3 max
1.8
1.6
11.0
7Z08630.1

Net weight: 6.5 g

Torque on nut: min. 8 kg cm
(0.8 Newton metres)
max. 17 kg cm
(1.7 Newton metres)

Diameter of clearance hole: max. 5.2 mm
Accessories supplied on request: 56295

The mark shown applies
to the normal polarity type

All information applies to frequencies up to 50 kHz

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages [1]			200(R)	300(R)	400(R)	500(R)	600(R)	
Continuous reverse voltage	V_R	max.	200	300	400	500	600	V
Crest working reverse voltage	V_{RWM}	max.	200	300	400	500	600	V
Repetitive peak reverse voltage	V_{RRM}	max.	200	300	400	500	600	V
Non-repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	250	350	450	550	650	V

---

[1] To ensure thermal stability: $R_{th\ j\text{-}a} \leq 6.5\ ^{o}C/W$ (d.c.) or $\leq 13\ ^{o}C/W$ (a.c.).
For smaller heatsinks $T_{j\ max}$ should be derated (see page 4 upper graph)

RATINGS (continued)

Currents

Average forward current (averaged over any 20 ms period) up to T_{mb} = 110 °C	$I_{F(AV)}$	max.	6	A
at T_{mb} = 125 °C	$I_{F(AV)}$	max.	4	A
Forward current (d.c.)	I_F	max.	10	A
R.M.S. forward current	$I_{F(RMS)}$	max.	10	A
Repetitive peak forward current	I_{FRM}	max.	40	A
Non-repetitive peak forward current t = 10 ms; T_j = 150 °C prior to surge	I_{FSM}	max.	80	A
I^2t for fusing (t = 10 ms)	I^2t	max.	32	A^2s
Repetitive peak reverse current (during turn-off)	I_{RRM}	max.	10	A

Temperatures

Storage temperature	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	50	°C/W
From junction to mounting base	$R_{th\ j-mb}$	=	3.5	°C/W
From mounting base to heatsink	$R_{th\ mb-h}$	=	0.5	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j-mb}$	=	1	°C/W

CHARACTERISTICS

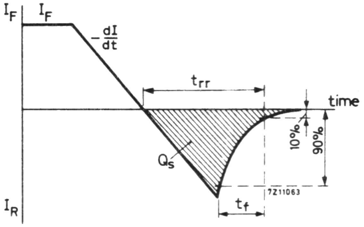
Forward voltage at I_F = 20 A; T_j = 25 °C	V_F	<	1.95	V
Peak reverse current at T_j = 125 °C $V_{RM} = V_{RWMmax}$	I_{RM}	<	1.4	mA

Reverse recovery when switched from

I_F = 1 A to V_R = 30 V with $-\frac{dI}{dt}$ = 100 A/μs; T_j = 150 °C	t_{rr}	<	200	ns

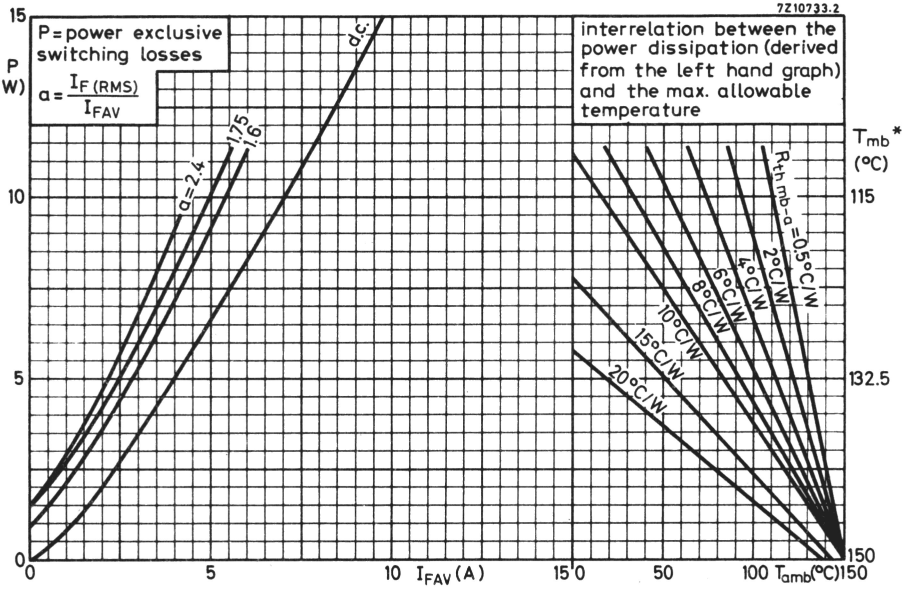
I_F = 4 A to V_R = 30 V with $-\frac{dI}{dt}$ = 4 A/μs; T_j = 25 °C

Recovery charge	Q_s	<	250	nC
Recovery time	t_{rr}	<	500	ns
Fall time	t_f	<	250	ns

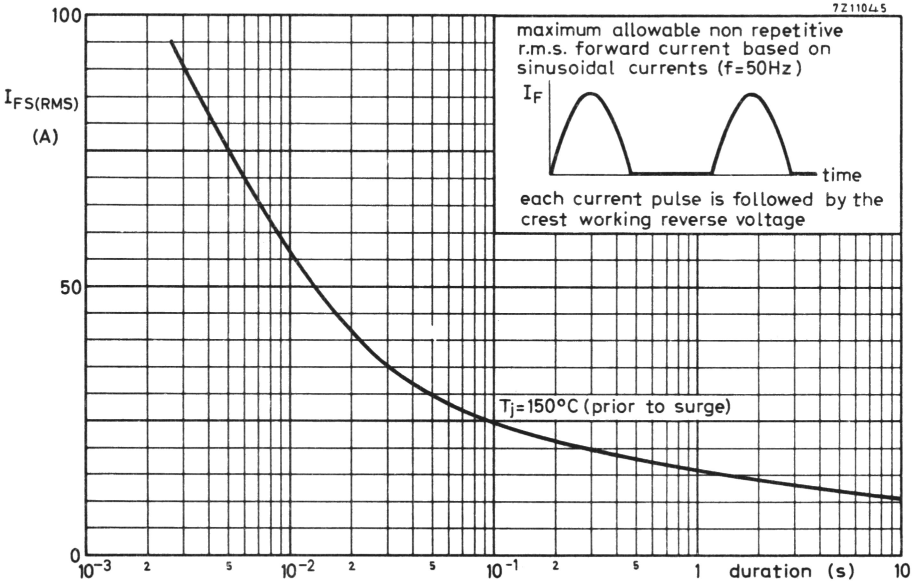


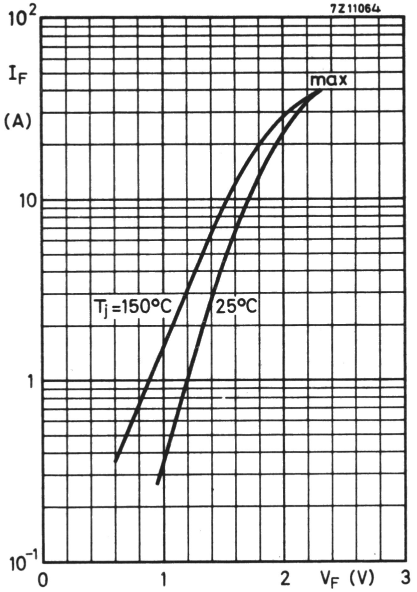
APPLICATION INFORMATION AND OPERATING NOTES

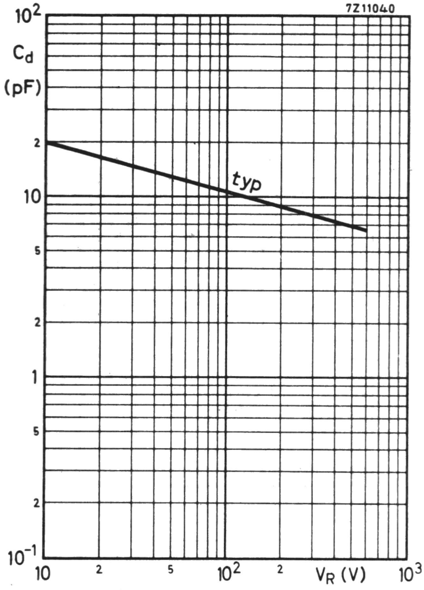
See general pages at the beginning of this section

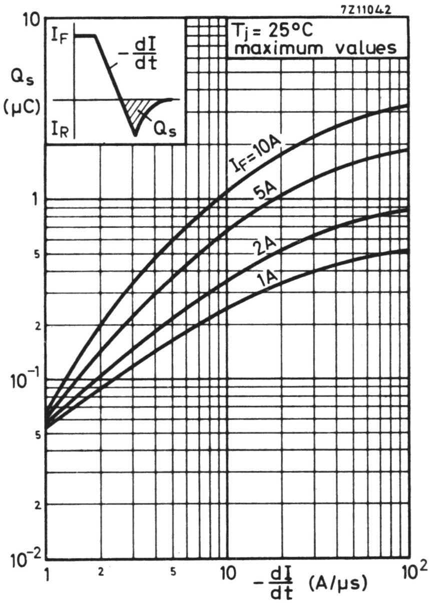


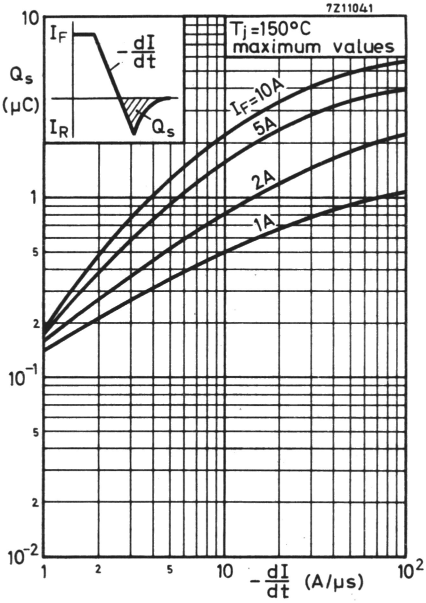
*) T_{mb}-scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leq 9.5$ °C/W

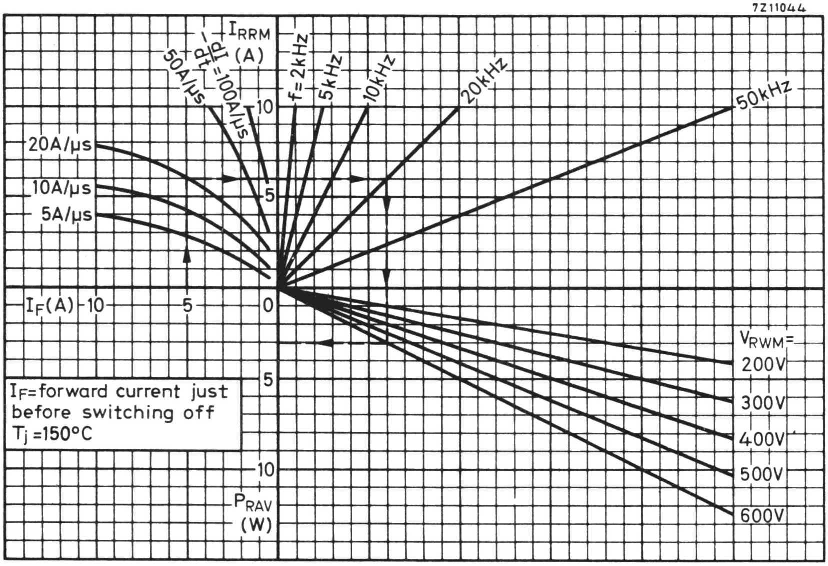



7Z11064
10^2
I_F
(A)
max
10
T_j = 150 °C
25 °C
1
10^{-1}
0
1
2
V_F (V)
3

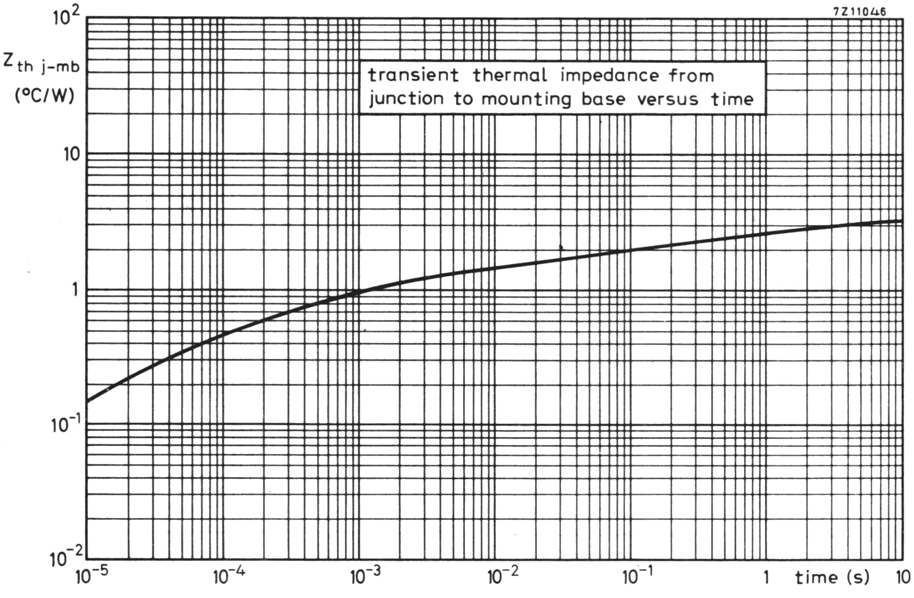

7Z11040
10^2
C_d
(pF)
2
typ
10
5
2
1
5
2
10^{-1}
10
2
5
10^2
2
V_R (V)
10^3

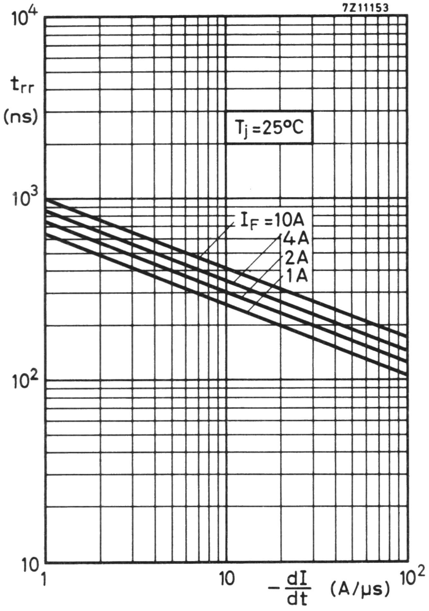

7Z11042
10
I_F
$-\frac{dI}{dt}$
Q_s
(µC)
I_R
Q_s
T_j = 25 °C
maximum values
I_F = 10A
5A
2A
1A
1
5
2
10^{-1}
5
2
10^{-2}
1
2
5
10
$-\frac{dI}{dt}$ (A/µs)
10^2

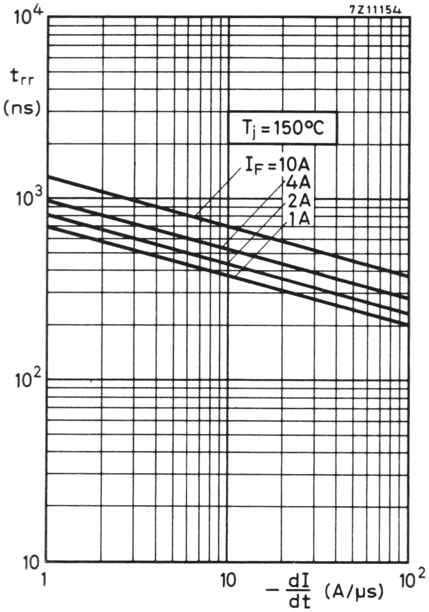

7Z11041
10
I_F
$-\frac{dI}{dt}$
Q_s
(µC)
I_R
Q_s
T_j = 150 °C
maximum values
I_F = 10A
5A
2A
1A
1
5
2
10^{-1}
5
2
10^{-2}
1
2
5
10
$-\frac{dI}{dt}$ (A/µs)
10^2



Nomogram: Power loss P_{RAV} due to switching only (square wave operation)




7Z11153
10^4
t_{rr}
(ns)
$T_j = 25$°C
10^3
$I_F = 10$A
4A
2A
1A
10^2
10
1
10
$-\frac{dI}{dt}$ (A/μs)
10^2

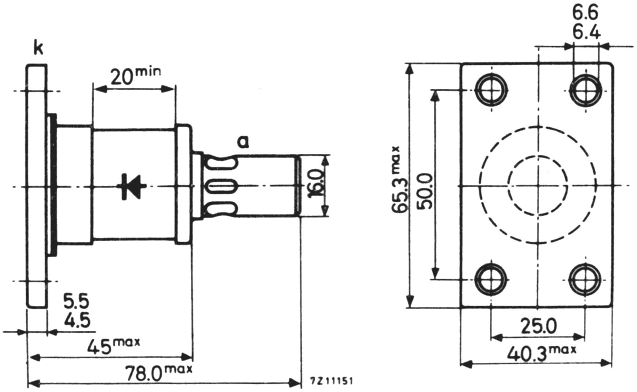

7Z11154
10^4
t_{rr}
(ns)
$T_j = 150$°C
$I_F = 10$A
4A
2A
1A
10^3
10^2
10
1
10
$-\frac{dI}{dt}$ (A/μs)
10^2

SILICON RECTIFIER DIODES

Diffused silicon diodes, with bevelled crystal, in metal envelopes with ceramic insulation, intended for power rectifier applications.
The series consists of the following types:
Normal polarity: (cathode to stud): BYX51-1200; -1600; -2000
Reverse polarity: (anode to stud) : BYX51-1200R; -1600R; -2000R

QUICK REFERENCE DATA

		BYX51-	1200(R)	1600(R)	2000(R)	
Crest working reverse voltage	V_{RWM}	max.	800	1200	1200	V
Repetitive peak reverse voltage	V_{RRM}	max.	1200	1600	2000	V
Average forward current up to T_{mb} = 115 °C	I_{FAV}		max.	400	A	
Non repetitive peak forward current (t = 10 ms) T_j = 190 °C prior to surge	I_{FSM}		max.	6000	A	
Junction temperature	T_j		max.	190	°C	



Net weight: 250 g
Normal polarity (cathode to stud, -|◀-); blue circle on top
Reverse polarity (anode to stud, -▶|-); red circle on top
Accessories and mounting instructions: see page 3.

All information applies to frequencies up to 400 Hz

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages [1]		BYX51 -	1200(R)	1600(R)	2000(R)	
Continuous reverse voltage	V_R	max.	800	1200	1200	V
Crest working reverse voltage	V_{RWM}	max.	800	1200	1200	V
Repetitive peak reverse voltage ($\delta \leq 0.01$)	V_{RRM}	max.	1200	1600	2000	V [2]
Non repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	1200	1600	2000	V [2]

Currents				
Average forward current (averaged over any 20 ms period) up to T_{mb} = 115 °C	I_{FAV}	max.	400	A
Forward current (d.c.)	I_F	max.	625	A
R.M.S. forward current	$I_{F(RMS)}$	max.	625	A
Repetitive peak forward current	I_{FRM}	max.	2000	A
Non repetitive peak forward current t = 10ms; half sine wave; T_j = 190 °C prior to surge	I_{FSM}	max.	6000	A
I squared t for fusing (t = 10 ms)	I^2t	max.	180 000	A^2s
Intermittent operation	See page 7			

Temperatures				
Storage temperature	T_{stg}		−55 to +200	°C
Junction temperature	T_j	max.	190	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	0.13	°C/W
From mounting base to heatsink without heatsink compound	$R_{th\ mb\text{-}h}$	=	0.07	°C/W
From mounting base to heatsink with heatsink compound (e.g. Dow Corning 340)	$R_{th\ mb\text{-}h}$	=	0.03	°C/W
Transient thermal impedance (t = 1 ms)	$Z_{th\ j\text{-}mb}$	=	0.01	°C/W

---

[1] To ensure thermal stability: $R_{th\ j\text{-}a} \leq 0.26$ °C/W (d.c.) or 0.52 °C/W (a.c.)

[2] a. Derate this value with 0.15 %/°C below T_j = 25 °C
b. See "OPERATING NOTE" 2, on page 4.

CHARACTERISTICS

Forward voltage at I_F = 1250 A; T_j = 25 °C V_F < 1.5 V [1]

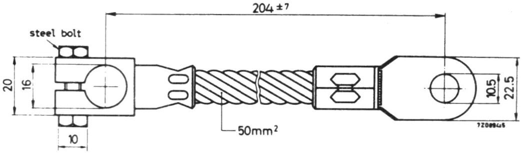
Peak reverse current at V_{RM} = V_{RWMmax}; T_j = 175 °C I_{RM} < 30 mA

ACCESSORIES AND MOUNTING INSTRUCTIONS

Dimensions in mm

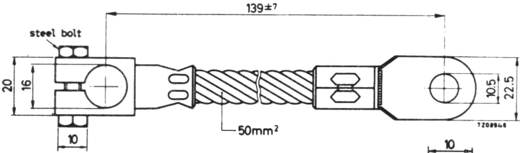
Flexible top lead

Type number 56243
Weight: 170 g


204 ±7
steel bolt
20
16
10
50mm²
10.5
22.5

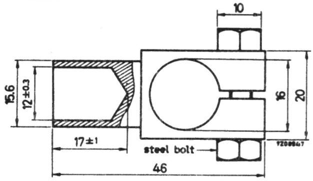
Flexible top lead

Type number 56243A
Weight: 140 g


139 ±7
steel bolt
20
16
10
50mm²
10.5
22.5

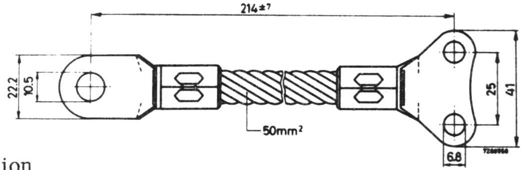
Clamp

Type number 56244
Weight: 70 g


10
15.6
12±0.3
16
20
17±1
steel bolt
46

Flexible base lead

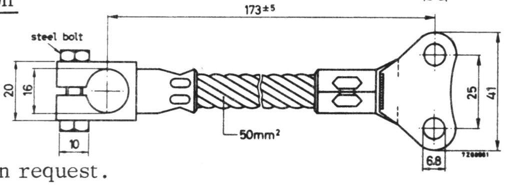
Type number 56247
Weight: 135 g


214 ±7
22.2
10.5
50mm²
25
41
6.8

Flexible top lead for series connection

Type number 56296

Weight: 155 g


173 ±5
steel bolt
20
16
10
50mm²
25
41
6.8

1. These accessories are **supplied** on request.
2. For mounting of the flexible top lead it is recommended to use two spanners to avoid damage.
   Torque on nut: min. 30 kg cm (3 Newton-metres); max. 60 kg cm (6 Newton-metres)
3. For mounting the diode on a heatsink use steel bolts.
   Min. torque for good thermal and electrical contact: 30 kg cm (3 Newton-metres)
   Max. torque : 60 kg cm (6 Newton-metres)
4. Top lead 56243 should only be used for $I_{F(RMS)} \leq 400$ A
   Top lead 56243A is necessary for $I_{F(RMS)} > 400$ A to prevent excessive temperature of the top connection.

---

[1] Measured under pulsed conditions to avoid excessive dissipation.

OPERATING NOTES (See also general pages at the beginning of this section)

1. The diode should be shunted by a 0.5 μF capacitor in series with a 10 Ω resistor (recovery phenomena).
   Leads should be as short as possible to keep the inductance to a minimum.

2. Parallel operation

   The nominal current rating of each diode must be derated by a factor d:

$$d = 0.8 + \frac{0.2}{n}$$

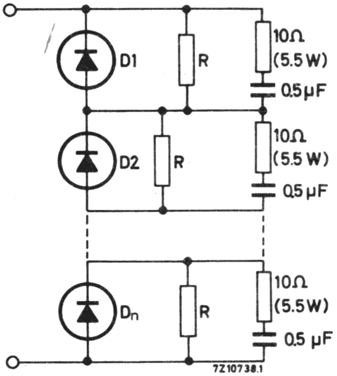
   in which n stands for the number of diodes to be connected in parallel. If fuses are connected in series with each diode, a less severe derating factor can be used:

$$d' = 0.85 + \frac{0.15}{n}$$

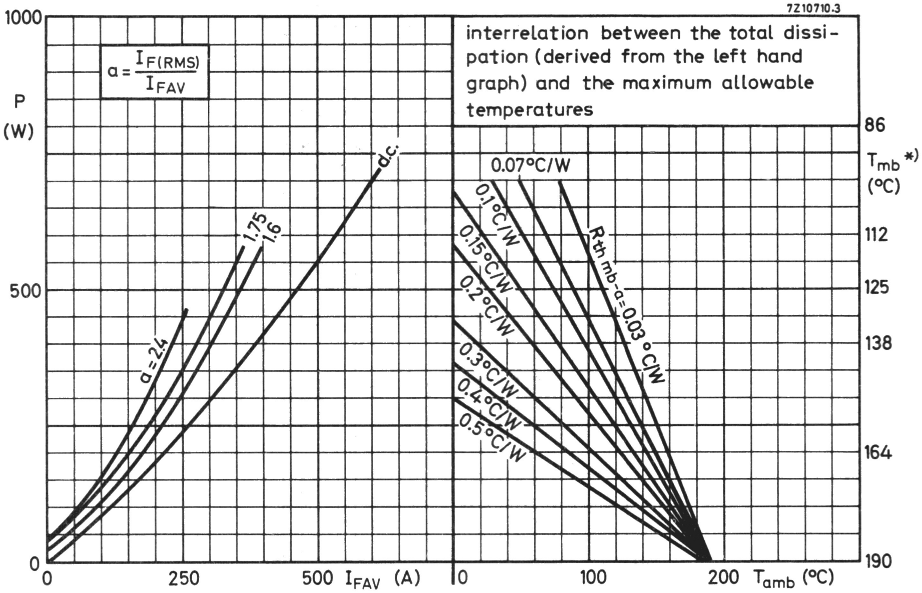
3. Series operation

For series connection the following elements are necessary:

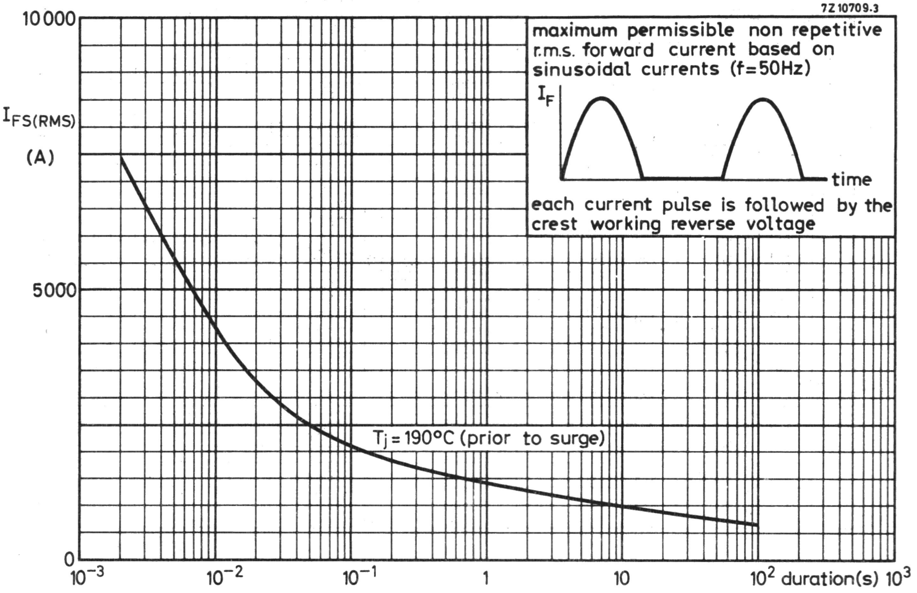
	BYX51-1200(R)	BYX51-1600(R) BYX51-2000(R)	
$n \geq$	$1.88\ V_{RWMtot} - 0.5$	$1.25\ V_{RWMtot} - 0.5$	
R	2.2	3.3	kΩ
P(R) (single phase rectifier)	75	115	W
P(R) (poly phase rectifier)	120	180	W

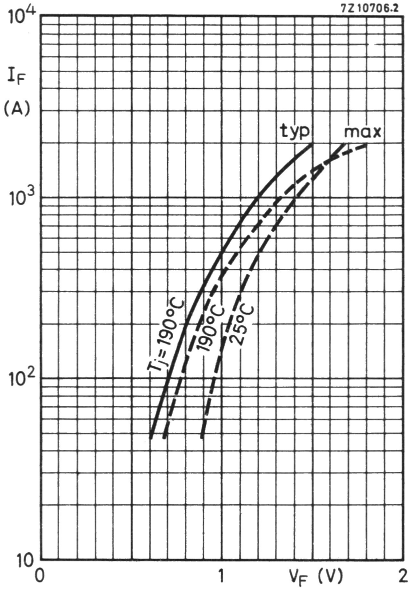


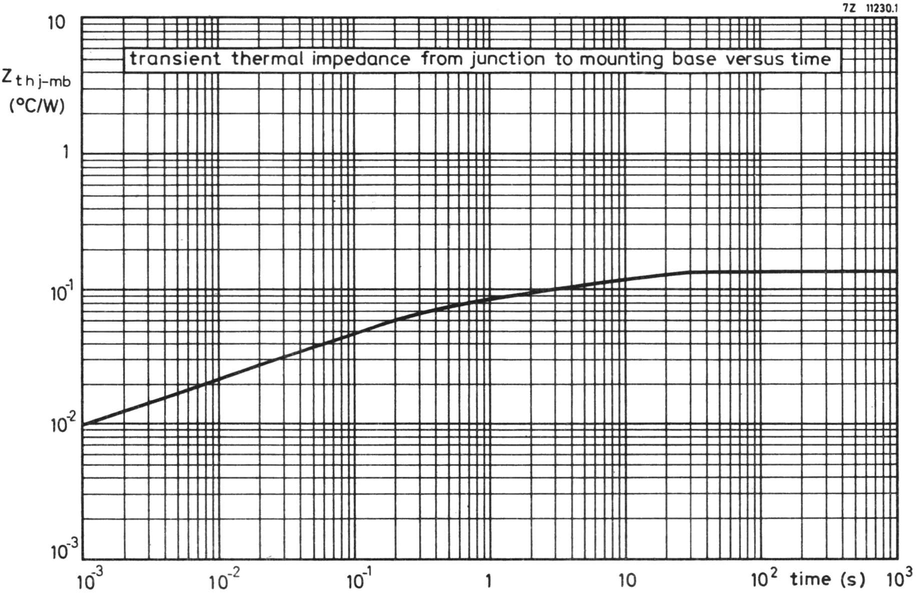
n = number of diodes in series
P(R) = power rating of R
V_{RWMtot} = crest working voltage across diode string, including maximum expected voltage fluctuation (in kV)



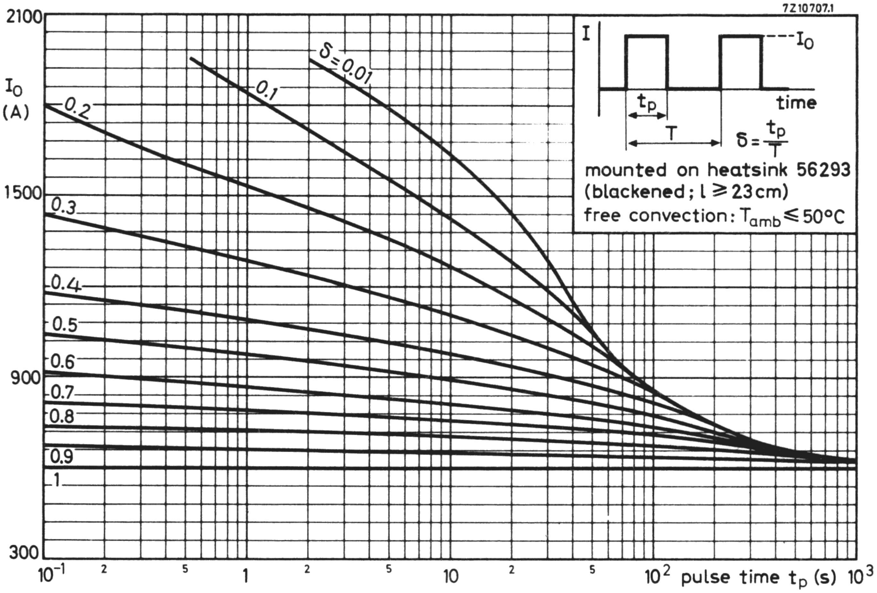
*) T_{mb}-scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leq 0.39$ °C/W

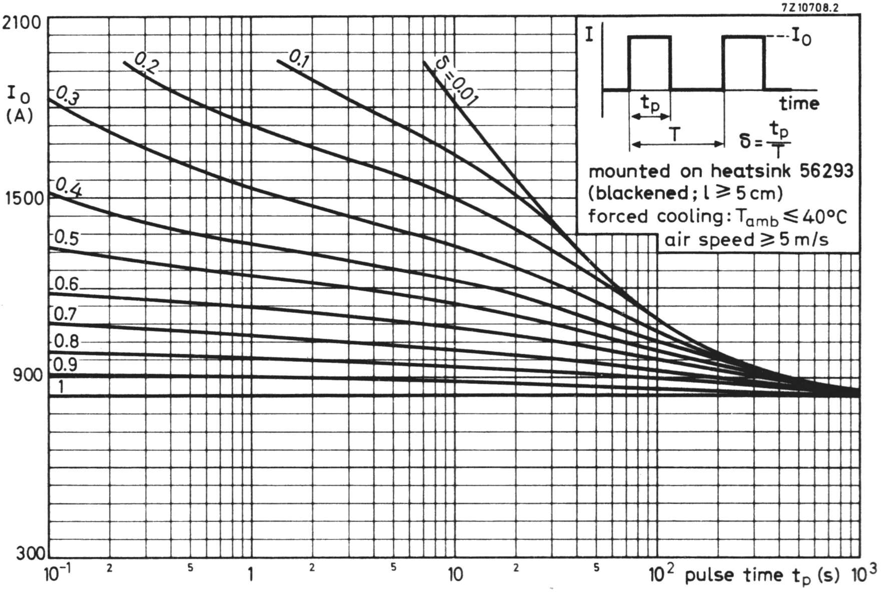



7Z10706.2
10^4
I_F
(A)
typ
max
10^3
$T_j = 190$ °C
190 °C
25 °C
10^2
10
0
1
V_F (V)
2


7Z 11230.1
10
transient thermal impedance from junction to mounting base versus time
$Z_{th\ j\text{-}mb}$
(°C/W)
1
10^{-1}
10^{-2}
10^{-3}
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
time (s)
10^3

MAXIMUM ALLOWABLE OUTPUT CURRENT OF A 3-PHASE BRIDGE RECTIFIER UNDER INTERMITTENT LOAD





SILICON RECTIFIER DIODES

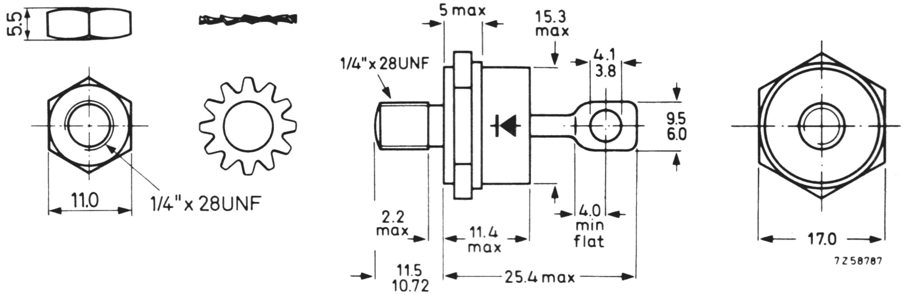
Silicon rectifier diodes in a DO-5 metal envelope intended for power rectifier applications. The series consists of the following types.
Normal polarity (cathode to stud): BYX52-300 to BYX52-1200
Reverse polarity (anode to stud) : BYX52-300R to BYX52-1200R.

QUICK REFERENCE DATA

			BYX52-300(R)	600(R)	900(R)	1200(R)	
Crest working reverse voltage	V_{RWM}	max.	200	400	600	800	V
Repetitive peak reverse voltage	V_{RRM}	max.	300	600	900	1200	V
Average forward current up to T_{mb} = 110°C	$I_{F(AV)}$	max.	48				A
at T_{mb} = 125°C	$I_{F(AV)}$	max.	40				A
Non-repetitive peak forward current (t = 10 ms) T_j = 175°C prior to surge	I_{FSM}	max.	800				A
Junction temperature	T_j	max.	175				°C/W

MECHANICAL DATA Dimensions in mm

DO-5



Net weight: 20.5 g
Diameter of clearance hole: max. 6.5 mm
Accessories supplied on request:
56264A; 56309B; 56309R
The mark shown applies to the normal polarity types

Torque on nut: min. 17.5 kg cm
(1.75 Newton-metres)
max. 35 kg cm
(3.5 Newton-metres)

All information applies to frequencies up to 400 Hz

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages			BYX52-300(R)	600(R)	900(R)	1200(R)	
Crest working reverse voltage	V_{RWM}	max.	200	400	600	800	V
Repetitive peak reverse voltage ($\delta = 0.01$)	V_{RRM}	max.	300	600	900	1200	V
Non-repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	300	600	900	1200	V

Currents

Average forward current (averaged over any 20 ms period) up to $T_{mb} = 110\,^{o}C$	$I_{F(AV)}$	max.	48	A
at $T_{mb} = 125\,^{o}C$	$I_{F(AV)}$	max.	40	A
R.M.S. forward current	$I_{F(RMS)}$	max.	75	A
Forward current (d.c.)	I_F	max.	75	A
Repetitive peak forward current	I_{FRM}	max.	450	A
Non-repetitive peak forward current ($t = 10$ ms; half sine wave) $T_j = 175\,^{o}C$ prior to surge	I_{FSM}	max.	800	A
I^2t for fusing ($t = 10$ ms)	I^2t	max.	3200	A^2s

Temperatures

Storage temperature	T_{stg}		-55 to +175	^{o}C
Junction temperature	T_j	max.	175	^{o}C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	0.8	$^{o}C/W$
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.2	$^{o}C/W$

CHARACTERISTICS

Forward voltage

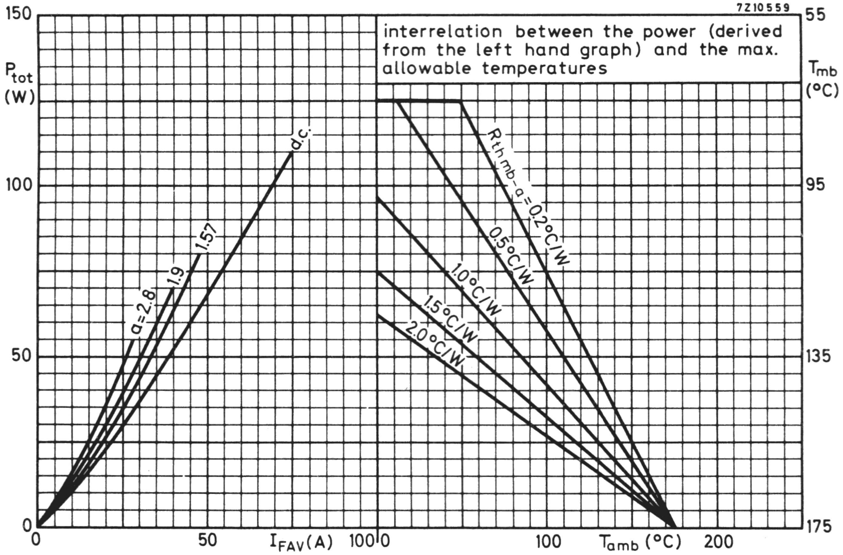
$I_F = 150$ A; $T_j = 25\,^{o}C$	V_F	<	1.8	V

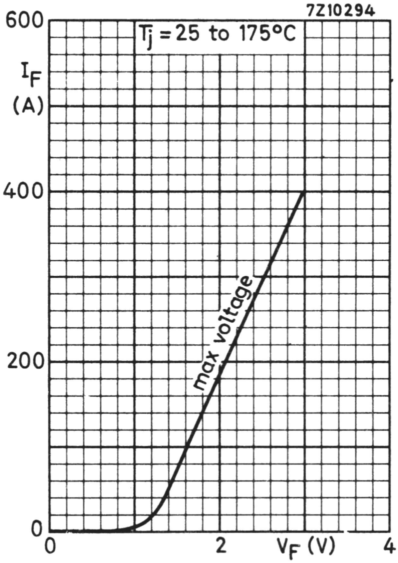
Peak reverse current

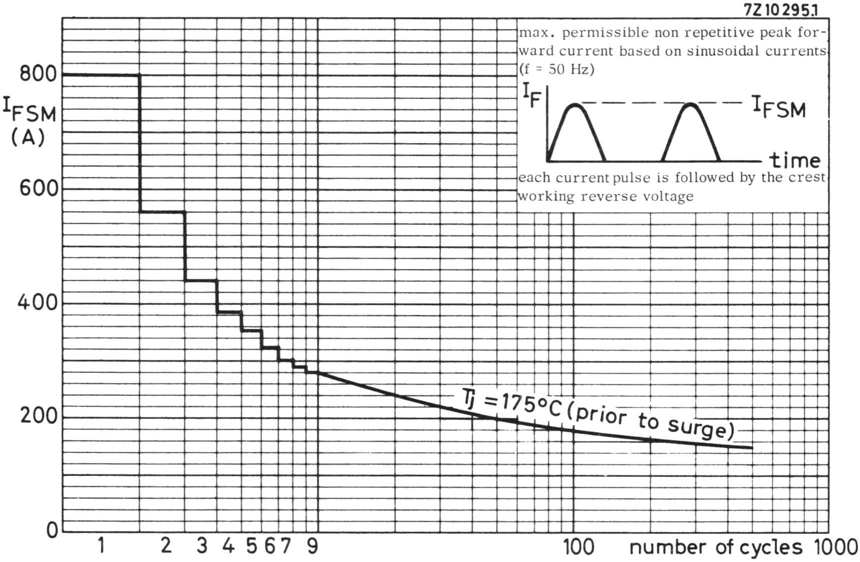
$V_{RM} = V_{RWMmax}$; $T_j = 125\,^{o}C$	I_{RM}	<	1.6	mA

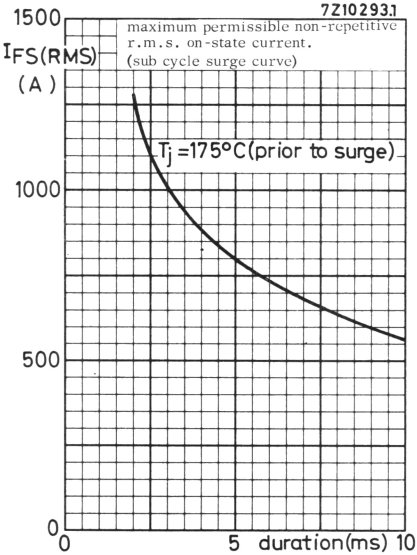
OPERATING NOTES (See also general pages at the beginning of this section)

The top connector should neither be bent nor twisted; it should be soldered into the circuit so that there is no strain on it.


7Z10559
150
P_tot (W)
100
50
0
a=2.8
1.9
1.57
d.c.
0
50
I_FAV (A)
100
interrelation between the power (derived from the left hand graph) and the max. allowable temperatures
R_th mb-a = 0.2 °C/W
0.5 °C/W
1.0 °C/W
1.5 °C/W
2.0 °C/W
0
100
T_amb (°C)
200
55
T_mb (°C)
95
135
175


7Z10294
T_j = 25 to 175°C
600
I_F (A)
400
200
0
max voltage
0
2
V_F (V)
4


7Z10295.1
max. permissible non repetitive peak forward current based on sinusoidal currents (f = 50 Hz)
I_F
I_{FSM}
time
each current pulse is followed by the crest working reverse voltage
800
I_{FSM} (A)
600
400
200
0
1
2
3
4
5
6
7
9
100
number of cycles
1000
T_j = 175°C (prior to surge)


7Z10293.1
maximum permissible non-repetitive r.m.s. on-state current. (sub cycle surge curve)
1500
$I_{FS(RMS)}$ (A)
1000
500
0
0
5
duration (ms)
10
T_j = 175°C (prior to surge)

CONTROLLED AVALANCHE RECTIFIER DIODES

Silicon diodes in a DO-5 metal envelope, capable of absorbing transients and intended for power rectifier applications.
The series consists of the following types:
Normal polarity (cathode to stud): BYX56-600; BYX56-800; BYX56-1000.
Reverse polarity (anode to stud): BYX56-600R; BYX56-800R; BYX56-1000R.

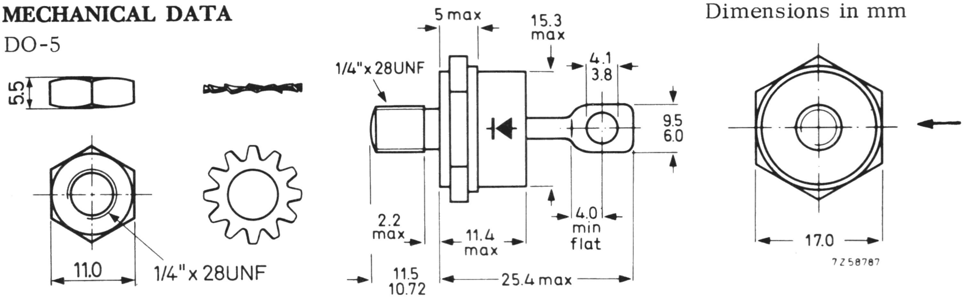
QUICK REFERENCE DATA

			BYX56-600(R)	800(R)	1000(R)	
Crest working reverse voltage	V_{RWM}	max.	600	800	1000	V
Reverse avalanche breakdown voltage	$V_{(BR)R}$	>	750	1000	1250	V
Average forward current up to T_{mb} = 110 °C	$I_{F(AV)}$	max.	47 A			
at T_{mb} = 125 °C	$I_{F(AV)}$	max.	40 A			
Non-repetitive peak forward current t = 10 ms; T_j = 175 °C prior to surge	I_{FSM}	max.	800 A			
Non-repetitive peak reverse power dissipation (t = 10 μs; T_j = 25 °C)	P_{RSM}	max.	40 kW			
Junction temperature	T_j	max.	175 °C			

MECHANICAL DATA

DO-5

Dimensions in mm



Net weight: 20.5 g
Diameter of clearance hole: max. 6.5 mm
Accesories supplied on request:
56264A; 56309B; 56309R

Torque on nut: min. 17.5 kg cm
(1.75 Newton-metres)
max. 35 kg cm
(3.5 Newton-metres)
The mark shown applies to normal polarity types

All information applies to frequencies up to 400 Hz

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages			BYX56-600(R)	800(R)	1000(R)	
Continuous reverse voltage	V_R	max.	600	800	1000	V
Crest working reverse voltage	V_{RWM}	max.	600	800	1000	V

Currents

Average forward current (averaged over any 20 ms period) up to T_{mb} = 110 °C	$I_{F(AV)}$	max.	47	A
at T_{mb} = 125 °C	$I_{F(AV)}$	max.	40	A
Forward current (d.c.)	I_F	max.	75	A
R.M.S. forward current	$I_{F(RMS)}$	max.	75	A
Repetitive peak forward current	I_{FRM}	max.	450	A
Non-repetitive peak forward current t = 10 ms; half sine-wave; T_j = 175 °C prior to surge	I_{FSM}	max.	800	A
I squared t for fusing (t ≤ 10 ms)	I^2t	max.	3200	A^2s

Reverse power dissipation

Repetitive peak reverse power dissipation t = 10 µs (square wave; f = 50 Hz) T_j = 175 °C	P_{RRM}	max.	6.5	kW
Non-repetitive peak reverse power dissipation t = 10 µs (square wave) T_j = 25 °C prior to surge	P_{RSM}	max.	40	kW
T_j = 175 °C prior to surge	P_{RSM}	max.	6.5	kW

Temperatures

Storage temperature	T_{stg}		−55 to +175	°C
Junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

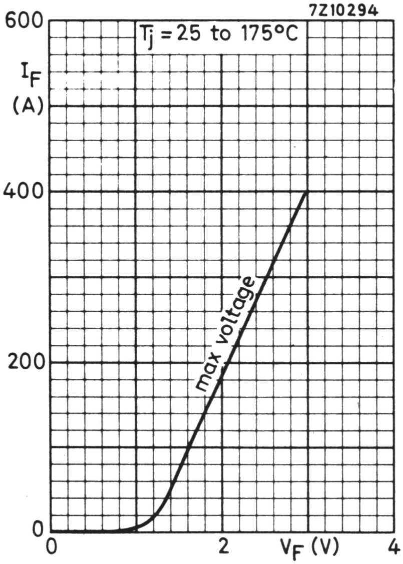
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	0.8	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.2	°C/W
Transient thermal impedance (t = 1 ms)	$Z_{th\ j\text{-}h}$	=	0.03	°C/W

CHARACTERISTICS

			BYX56-600(R)	800(R)	1000(R)	
Forward voltage at I_F = 150 A; T_j = 25 °C	V_F	<	1.8	1.8	1.8	V [1]
Reverse avalanche breakdown voltage						
I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	>	750	1000	1250	V
		<	2000	2000	2000	V
Peak reverse current						
$V_{RM} = V_{RWMmax}$; T_j = 125 °C	I_{RM}	<	1.6	1.6	1.6	mA

OPERATING NOTES (see general pages at the beginning of this section)

The top connector should neither be bent nor twisted; it should be soldered into the circuit so that there is no strain on it.
During soldering the heat conduction to the junction should be kept to a minimum by using a thermal shunt.



APPLICATION INFORMATION

See general pages at the beginning of this section

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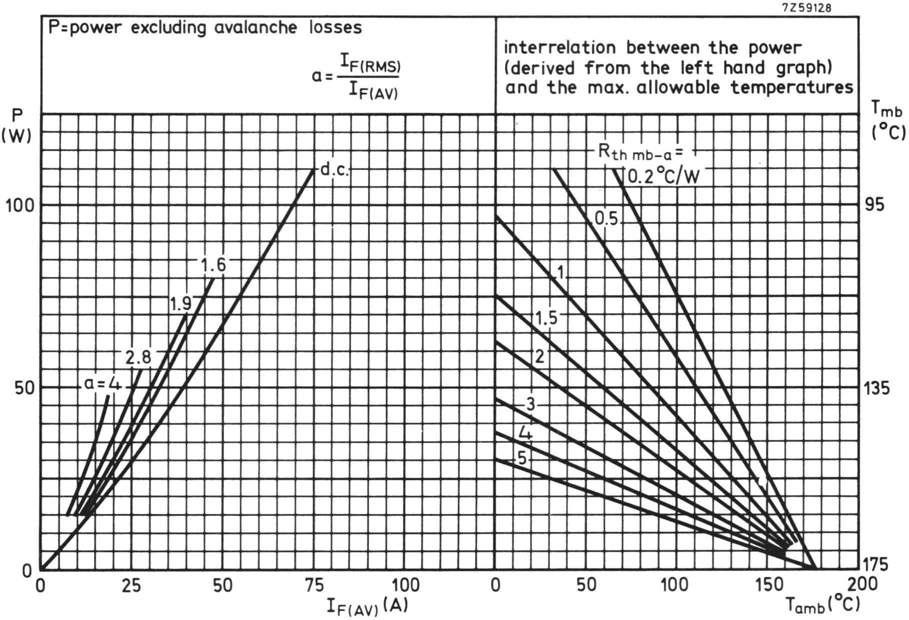
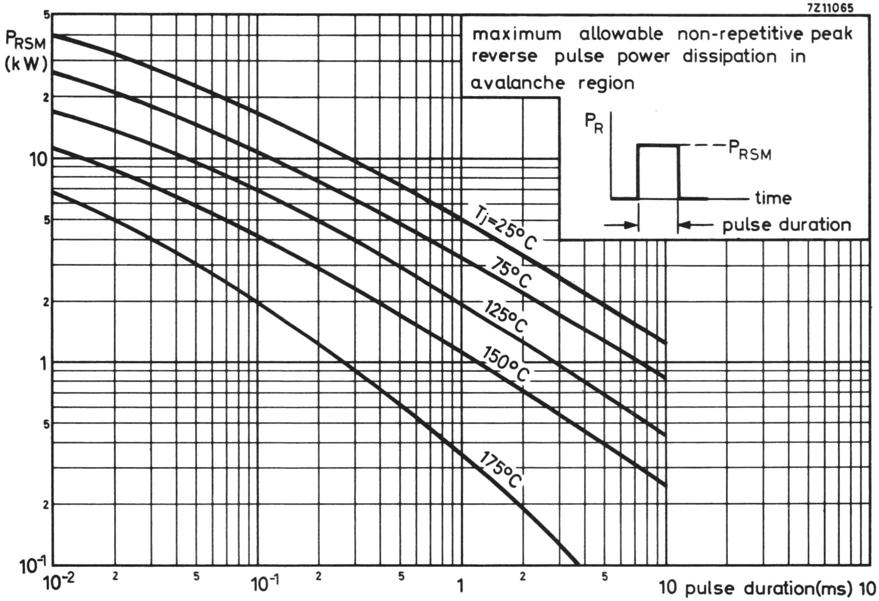
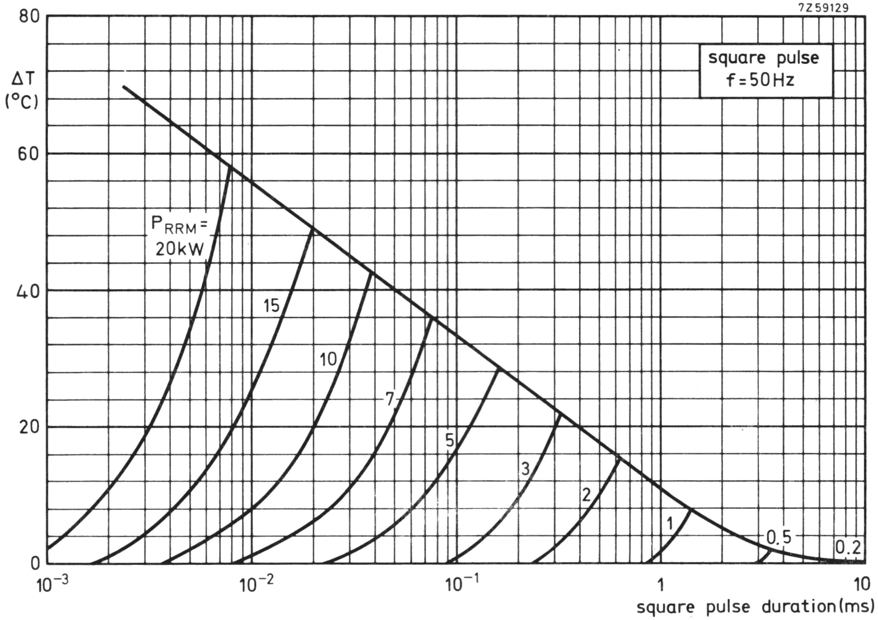
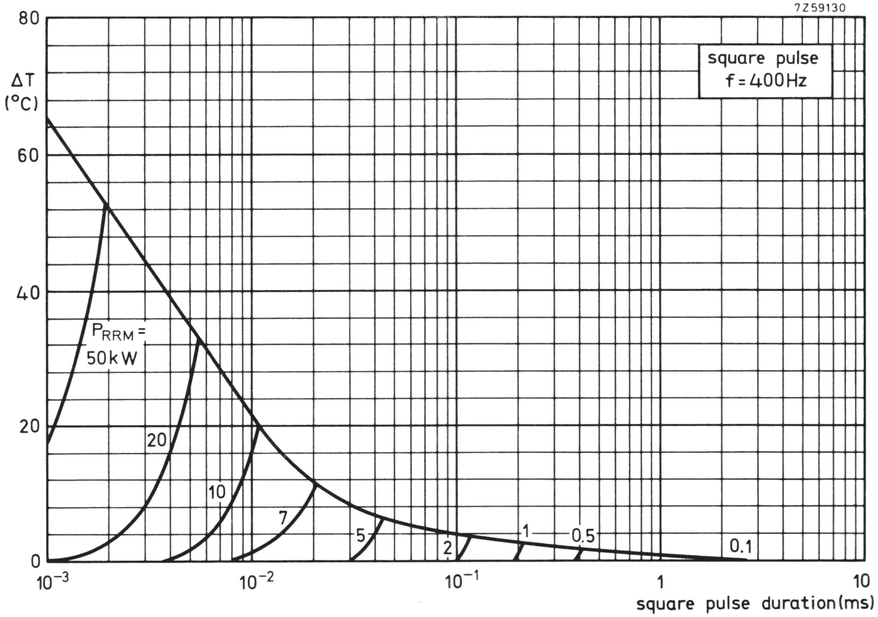
[1] Measured under pulsed conditions to avoid excessive dissipation.

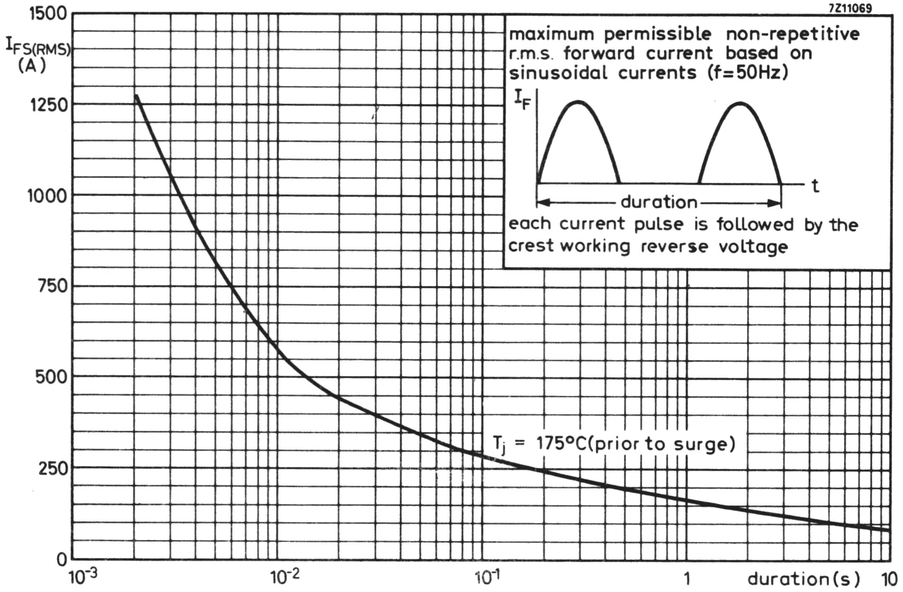

7Z59128
P=power excluding avalanche losses
$a = \frac{I_{F(RMS)}}{I_{F(AV)}}$
interrelation between the power (derived from the left hand graph) and the max. allowable temperatures
P (W)
100
50
0
d.c.
1.6
1.9
2.8
a=4
0
25
50
75
100
$I_{F(AV)}$ (A)
$R_{th\ mb-a}$ =
0.2 °C/W
0.5
1
1.5
2
3
4
5
0
50
100
150
200
T_{amb} (°C)
T_{mb} (°C)
95
135
175

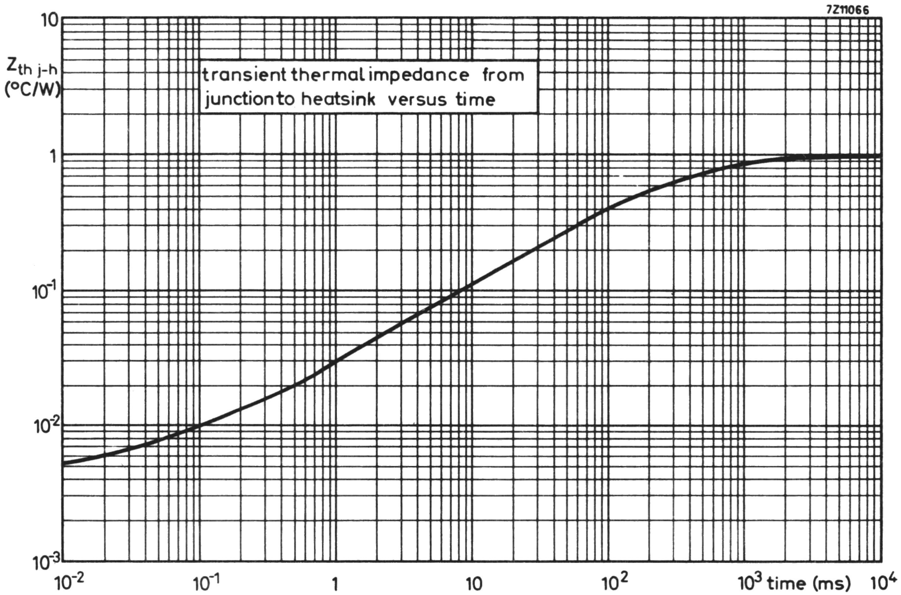

7Z11065
maximum allowable non-repetitive peak reverse pulse power dissipation in avalanche region
P_{RSM} (kW)
5
2
10
5
2
1
5
2
10^{-1}
P_R
P_{RSM}
time
pulse duration
T_j=25°C
75°C
125°C
150°C
175°C
10^{-2}
2
5
10^{-1}
2
5
1
2
5
10 pulse duration(ms) 10





ΔT = neccessary derating of $T_{j\,max}$ to accommodate repetitive transients in the reverse direction. Allowance can be made for this by assuming the ambient temperature ΔT higher.


7Z11069
1500
1250
1000
750
500
250
0
$I_{FS(RMS)}$ (A)
10^{-3}
10^{-2}
10^{-1}
1
duration(s)
10
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f=50Hz)
I_F
t
duration
each current pulse is followed by the crest working reverse voltage
T_j = 175°C(prior to surge)


7Z11066
10
1
10^{-1}
10^{-2}
10^{-3}
$Z_{th\ j-h}$ (°C/W)
transient thermal impedance from junction to heatsink versus time
10^{-2}
10^{-1}
1
10
10^2
10^3
time (ms)
10^4

FAST RECOVERY RECTIFIER DIODES

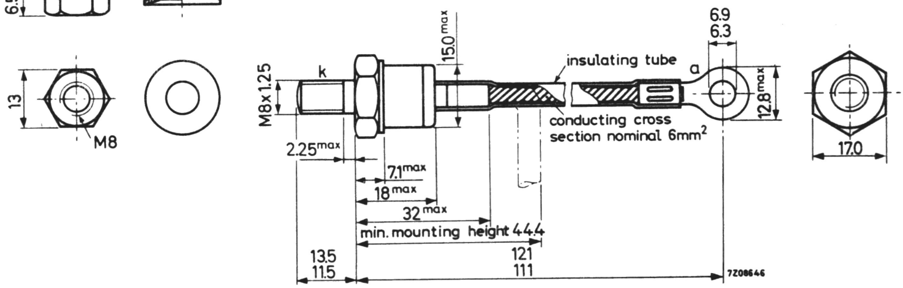
Diffused silicon diodes in a metal envelope, primarily intended for use in high frequency power supplies, inverters, choppers, sonar power supplies and ultra-sonic systems.
The series consists of the normal polarity types (cathode to stud) BYX59-200 to -500.

QUICK REFERENCE DATA

			BYX59 – 200	300	400	500	
Crest working reverse voltage	V_{RWM}	max.	200	300	400	500	V
Repetitive peak reverse voltage	V_{RRM}	max.	200	300	400	500	V
Average forward current up to $T_{mb} = 105\ ^{\circ}C$	$I_{F(AV)}$	max.	70				A
at $T_{mb} = 125\ ^{\circ}C$	$I_{F(AV)}$	max.	40				A
Non-repetitive peak forward current $t = 10$ ms; $T_j = 150\ ^{\circ}C$ prior to surge	I_{FSM}	max.	1200				A
Junction temperature	T_j	max.	150				$^{\circ}C$
Reverse recovery time when switched from $I_F = 50$ A to $V_R \geq 30$ V with $-\frac{dI}{dt} = 50$ A/µs; $T_j = 25\ ^{\circ}C$	trr	<	0.7				µs

MECHANICAL DATA

Dimensions in mm


6.5
13
M8
M8x1.25
k
2.25max
15.0max
insulating tube
a
6.9
6.3
12.8max
17.0
conducting cross section nominal 6mm²
7.1max
18max
32max
min. mounting height 44.4
13.5
11.5
121
111
7Z08646

Net weight: 42 g
Diameter of clearance hole: max. 8.5 mm

Torque on nut: min 40 kg cm
(4 Newton-metres)
max. 60 kg cm
(6 Newton-metres)

All information applies to frequencies up to 50 kHz

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages [1]			BYX59 – 200	300	400	500	
Continuous reverse voltage	V_R	max.	200	300	400	500	V
Crest working reverse voltage	V_{RWM}	max.	200	300	400	500	V
Repetitive peak reverse voltage	V_{RRM}	max.	200	300	400	500	V
Non-repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	220	330	440	550	V

Currents

Average forward current (averaged over any 20 ms period) up to T_{mb} = 105 °C	$I_{F(AV)}$	max.	70	A
at T_{mb} = 125 °C	$I_{F(AV)}$	max.	40	A
Forward current (d. c.)	I_F	max.	120	A
R. M. S. forward current	$I_{F(RMS)}$	max.	120	A
Repetitive peak forward current	I_{FRM}	max.	1000	A
Non-repetitive peak forward current ($t = 10$ ms; half sine wave) T_j = 150 °C prior to surge	I_{FSM}	max.	1200	A
I squared t for fusing ($t = 10$ ms)	I^2t	max.	7200	A^2s
Rate of change of commutation current	$-\frac{dI}{dt}$	max.	100	A/µs

Temperatures

Storage temperature	T_{stg}		-65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL

From junction to mounting base	$R_{th\ j-mb}$	=	0.4	°C/W
From mounting base to heatsink without heatsink compound	$R_{th\ mb-h}$	=	0.4	°C/W
with heatsink compound (e. g. Dow Corning 340)	$R_{th\ mb-h}$	=	0.2	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j-mb}$	=	0.045	°C/W

---

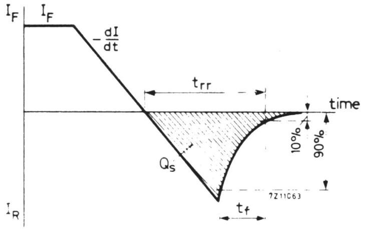
[1] To ensure thermal stability $R_{th\ j-a} \leq 0.75$ °C/W (continuous reverse voltage) or ≤ 1.5 °C/W (a.c.)
For smaller heatsinks $T_{j\ max}$ should be derated. For a.c. see page 4.
For continuous reverse voltage: $R_{th\ j-a} = 1$ °C/W, then $T_{j\ max} = 145$ °C
$R_{th\ j-a} = 1.2$ °C/W, then $T_{j\ max} = 140$ °C

CHARACTERISTICS

			BYX59 – 200	300	400	500	
Forward voltage I_F = 250 A; T_j = 25 °C	V_F	<	1.8	1.8	1.8	1.8	V 1)
Peak reverse current $V_{RM} = V_{RWM\,max}$; T_j = 125 °C	I_{RM}	<	25	25	18	15	mA

Reverse recovery when switched from
I_F = 50 A to $V_R \geq 30$ V
with $-\frac{dI}{dt}$ = 50 A/µs; T_j = 25 °C

reverse recovery charge	Q_s	<	7.5	µC
reverse recovery time	t_{rr}	<	0.7	µs
fall time	t_f	<	0.3	µs



OPERATING NOTES See also general pages at the beginning of this section.

1. Square wave operation
   When I_F has been flowing sufficiently long for steady state to be established, there will be a charge due to minority carriers present. Before the device can block in the reverse direction this charge must be extracted. This extraction takes the form of a reverse transient (see figure above). The majority of the power dissipation due to the reverse transient occurs during t_f as the rectifier gradually becomes reverse biased, and the mean power will be proportional to the operating frequency. The mean value of this power loss can be derived from the graph on page 4.
2. Sine wave operation
   Power loss in sine wave operation will be considerably less owing to the much slower rate of change of the applied voltage (and consequently lower values of -dI/dt), so that power loss due to reverse recovery may be safely ignored for frequencies up to 20 kHz.

APPLICATION INFORMATION

See general pages at the beginning of this section.

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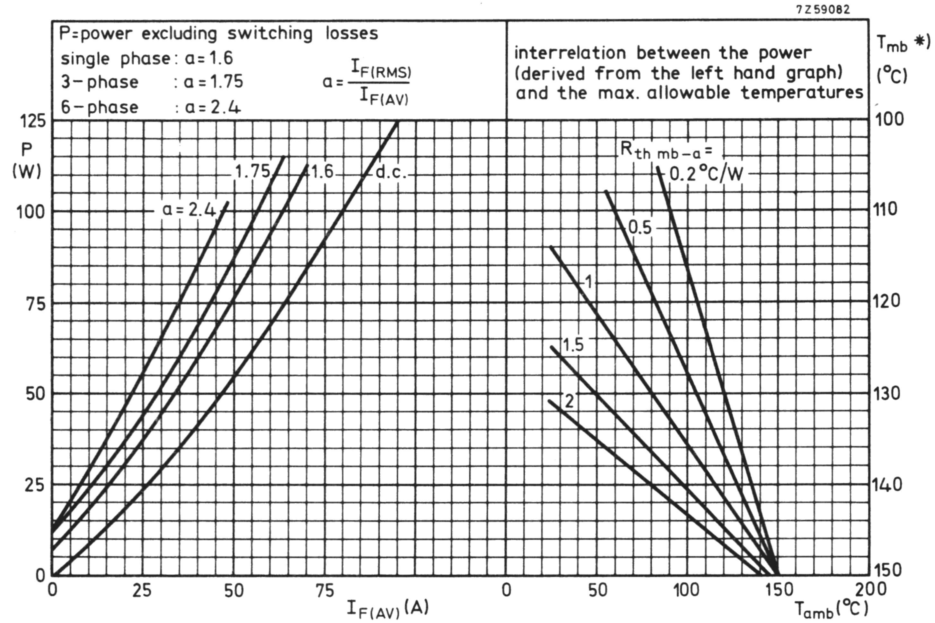
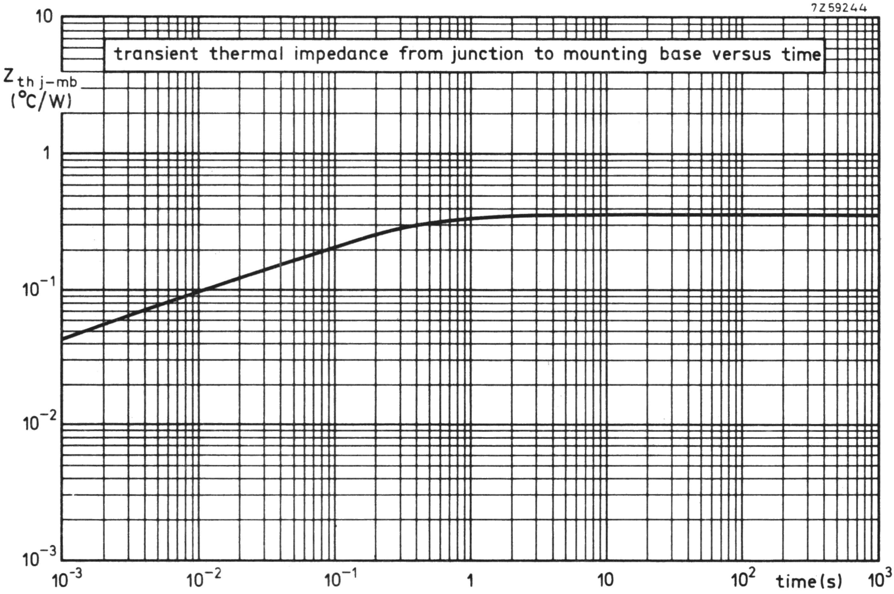
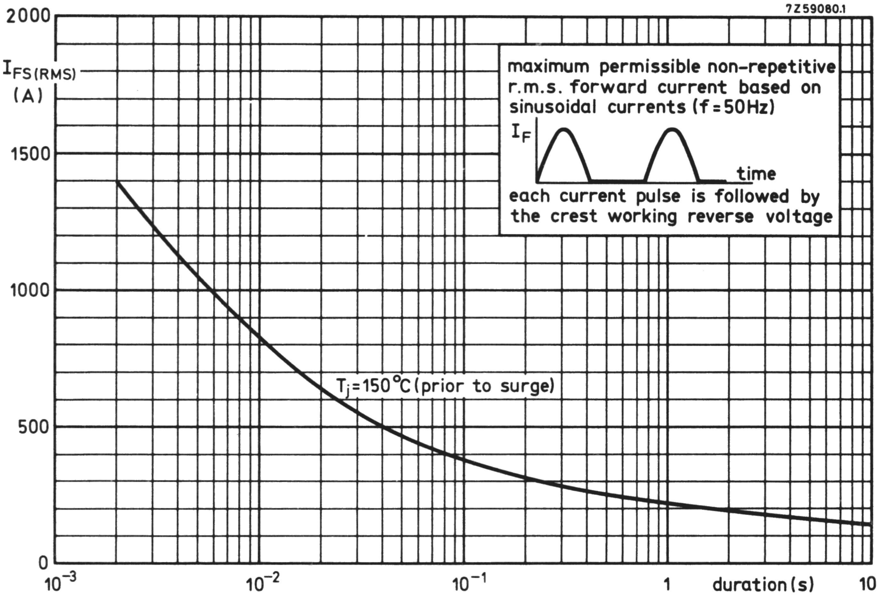
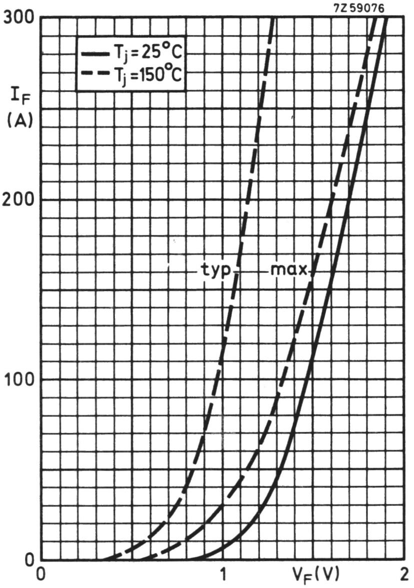
1) Measured under pulsed conditions to avoid excessive dissipation.

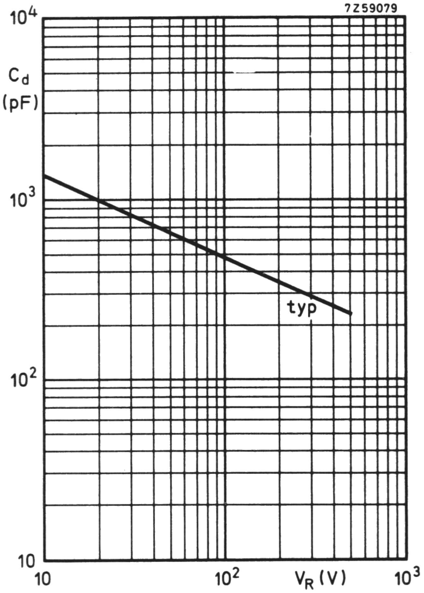


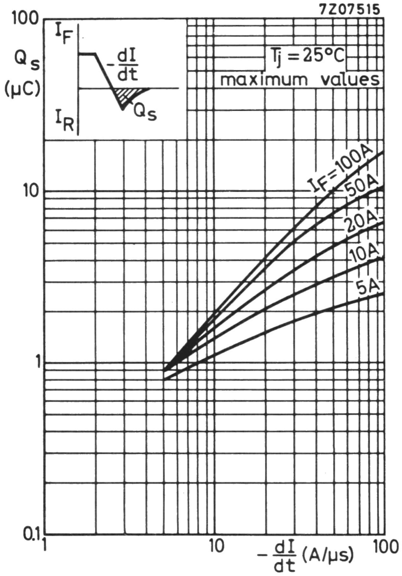
*) T_{mb}-scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leq 1.1\ ^{\circ}C/W$

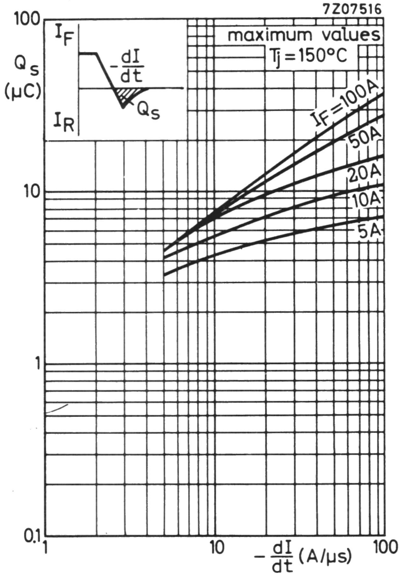


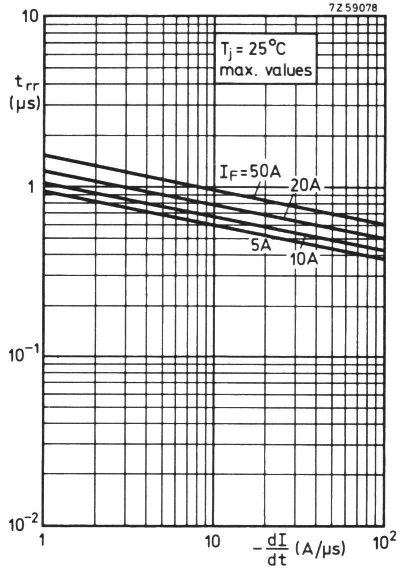

7Z59080.1
2000
$I_{FS(RMS)}$
(A)
1500
1000
500
0
10^{-3}
10^{-2}
10^{-1}
1
duration (s)
10
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50Hz)
I_F
time
each current pulse is followed by the crest working reverse voltage
$T_j = 150^\circ C$ (prior to surge)

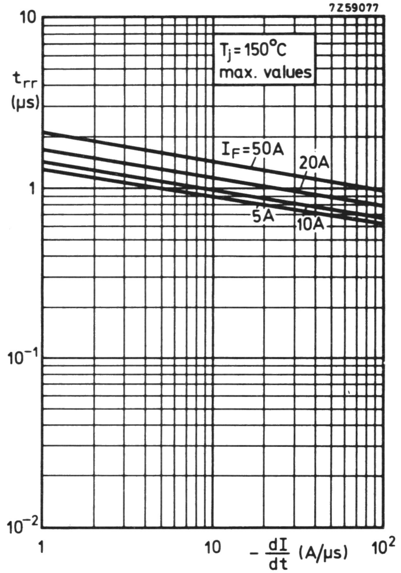

7Z59076
300
$T_j = 25^\circ C$
$T_j = 150^\circ C$
I_F
(A)
200
typ
max
100
0
0
1
V_F (V)
2

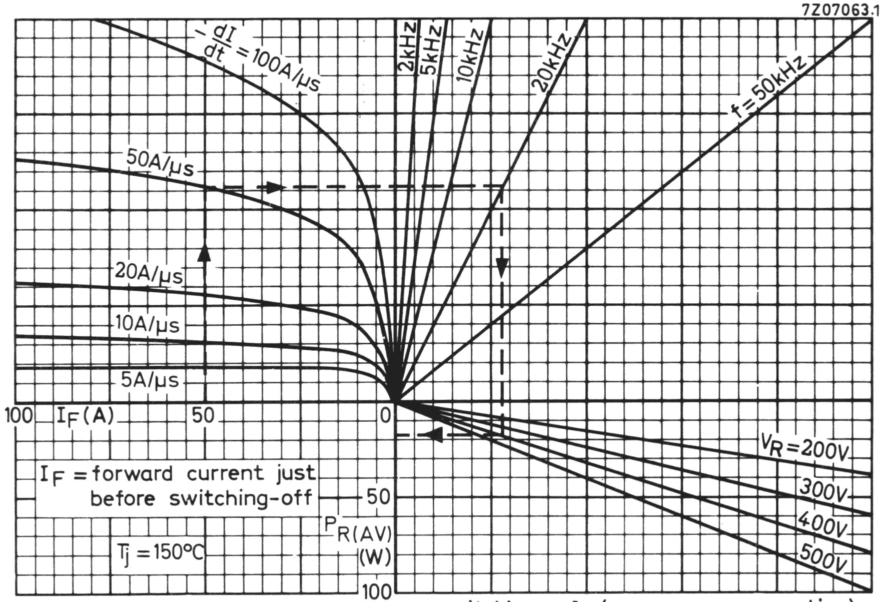

7Z59079
10^4
C_d
(pF)
10^3
typ
10^2
10
10
10^2
V_R (V)
10^3


7Z07515
Q_s (μC)
I_F
I_R
$-\frac{dI}{dt}$
Q_s
$T_j = 25°C$
maximum values
$I_F = 100A$
50A
20A
10A
5A
100
10
1
0.1
1
10
100
$-\frac{dI}{dt}$ (A/μs)


7Z07516
Q_s (μC)
I_F
I_R
$-\frac{dI}{dt}$
Q_s
maximum values
$T_j = 150°C$
$I_F = 100A$
50A
20A
10A
5A
100
10
1
0.1
1
10
100
$-\frac{dI}{dt}$ (A/μs)


7Z59078
t_{rr} (μs)
$T_j = 25°C$
max. values
$I_F = 50A$
20A
5A
10A
10
1
10^{-1}
10^{-2}
1
10
10^2
$-\frac{dI}{dt}$ (A/μs)

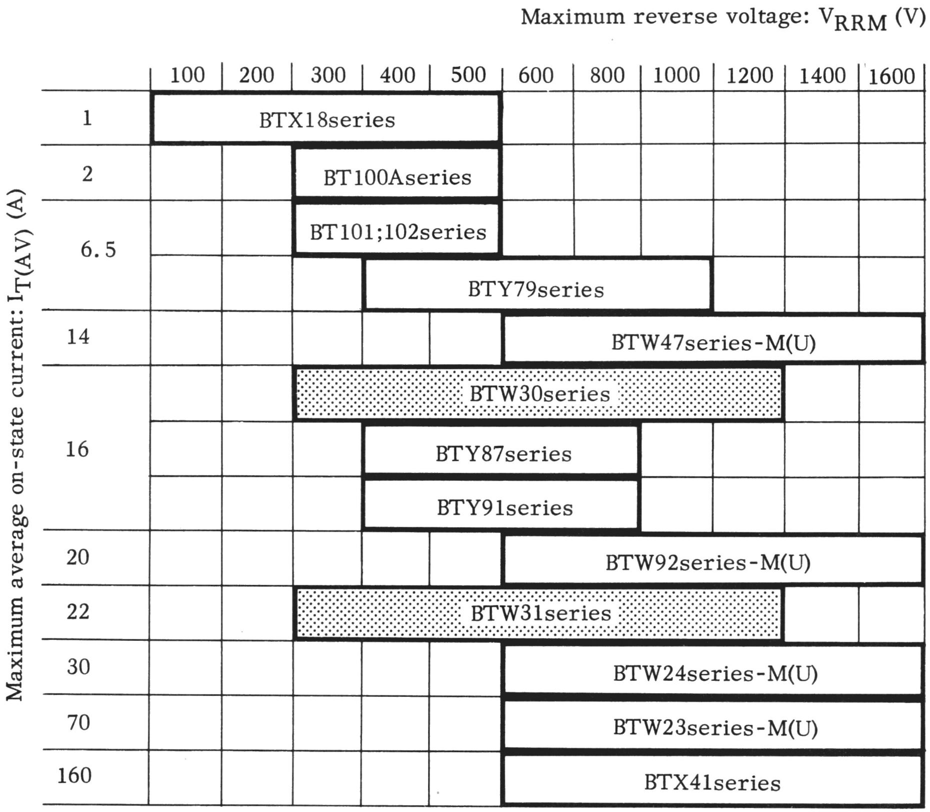

7Z59077
t_{rr} (μs)
$T_j = 150°C$
max. values
$I_F = 50A$
20A
5A
10A
10
1
10^{-1}
10^{-2}
1
10
10^2
$-\frac{dI}{dt}$ (A/μs)



Nomogram: Power loss $P_{R(AV)}$ due to switching only (square wave operation)

Thyristors, diacs, triacs

TYPE SELECTION CHART



☐ general purpose types

▨ fast turn-off types

Diac BR100 : $V_{(BO)}$ = 28 to 36 V; I_{FRM} = 2 A

Triac BTX94-400 to 1200 : $I_{T(RMS)}$ = 25 A

Thyristor tetrode BRY39 : 70 V; 250 mA

Pulse modulator thyristor BTX95-500R to 800R : $I_{T(RMS)}$ = 15 A

OPERATING NOTES

When there is a possibility that transients, due to the energy stored in the transformer, will exceed the maximum permissible non-repetitive peak reverse voltage [1]), a damping circuit should be connected across the transformer.
Either a series RC circuit or a voltage dependent resistor may be used. Suitable component values for an RC circuit across the transformer primary or secondary may be calculated as follows:

$\frac{V_{RSM}}{V_{RWM}}$	RC across primary of transformer		RC across secondary of transformer	
	C (μF)	R (Ω)	C (μF)	R (Ω)
2.0	$200\frac{I_{mag}}{V_1}$	$\frac{150}{C}$	$225\frac{I_{mag}T^2}{V_1}$	$\frac{200}{C}$
1.5	$400\frac{I_{mag}}{V_1}$	$\frac{225}{C}$	$450\frac{I_{mag}T^2}{V_1}$	$\frac{275}{C}$
1.25	$550\frac{I_{mag}}{V_1}$	$\frac{260}{C}$	$620\frac{I_{mag}T^2}{V_1}$	$\frac{310}{C}$
1.0	$800\frac{I_{mag}}{V_1}$	$\frac{300}{C}$	$900\frac{I_{mag}T^2}{V_1}$	$\frac{350}{C}$

where I_{mag} = magnetising primary r.m.s. current (A)
V_1 = transformer primary r.m.s. voltage (V)
V_2 = transformer secondary r.m.s. voltage (V)
T = V_1/V_2
V_{RSM} = the transient voltage peak produced by the transformer
V_{RWM} = the actually applied crest working reverse voltage

The capacitance values calculated from the above table are minimum values; to allow for circuit variations and component tolerances, larger values should be used.

---

[1]) For controlled avalanche types read: non-repetitive peak reverse power.

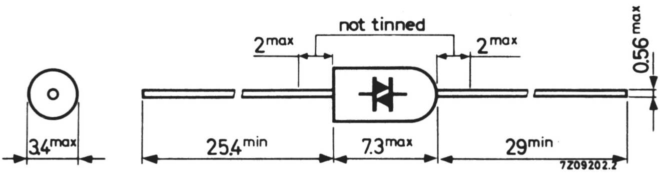
SILICON BI-DIRECTIONAL TRIGGER DEVICE

Silicon bi-directional trigger device in a DO-14 plastic envelope intended for use in triac and thyristor trigger circuits.

QUICK REFERENCE DATA				
Breakover voltage	$V_{(BO)}$	28 to 36		V
Breakback voltage at I_F = 10 mA	ΔV	>	6	V
Repetitive peak current ($t \leq 20\ \mu s$)	I_{FRM}	max.	2	A

MECHANICAL DATA Dimensions in mm

DO-14



The envelope fulfils the accelerated damp heat test described in I.E.C. publication 68.2 (test D, severity IV, 6 cycles).

RATINGS (Limiting values) [1]

Total power dissipation up to T_{amb} = 70 °C	P_{tot}	max.	150	mW
Repetitive peak current ($t \leq 20\ \mu s$)	I_{FRM}	max.	2	A
Storage temperature	T_{stg}	−65 to +100		°C
Junction temperature	T_j	max.	100	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.2	°C/mW

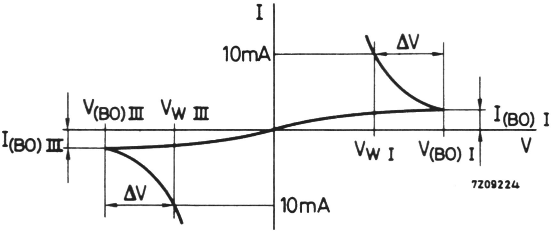
---

[1] Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

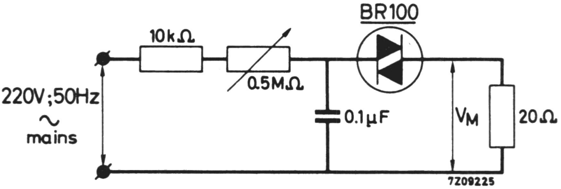
CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Breakover voltage at $\frac{dV}{dt}$ = 10 V/ms	$V_{(BO)}$		28 to 36	V
Breakover voltage symmetry	$\lvert V_{(BO)\,I} - V_{(BO)\,III} \rvert$	<	3	V
Breakback voltage I_F = 10 mA; $\frac{dV}{dt}$ = 10 V/ms	$\Delta V = V_{(BO)} - V_W$	>	6	V
Breakover current	$I_{(BO)}$	<	20	µA



Test circuit for peak output voltage


BR100
10kΩ
0.5MΩ
220V;50Hz
~
mains
0.1µF
V_M
20Ω
7Z09225

V_M measured across a resistor of 20 Ω (instead of a thyristor) will be > 5 V.

THYRISTOR TETRODE

The BRY39 is a planar p-n-p-n trigger device in a TO-72 metal envelope, intended for use in switching applications such as relay and lamp drivers, sensing network for temperature, etc.
For the applications of the BRY39 as SCS see Handbook Part 3, section SWITCHING TRANSISTORS and as PROGRAMMABLE UNIJUNCTION TRANSISTOR see Handbook Part 3, section SWITCHING TRANSISTORS.

QUICK REFERENCE DATA

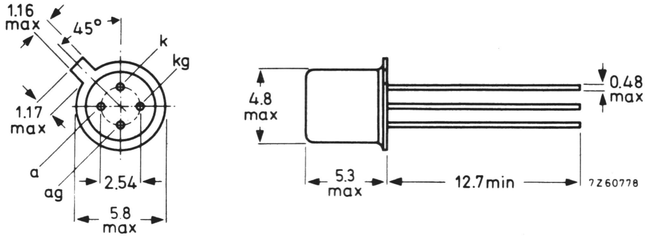
Continuous voltages	$V_D = V_R$	max.	70	V
Repetitive peak voltages	$V_{DRM} = V_{RRM}$	max.	70	V
On-state current up to T_{case} = 85 °C	I_T	max.	250	mA
Non-repetitive peak on-state current t = 10 μs; T_j = 150 °C prior to surge	I_{TSM}	max.	3	A
Junction temperature	T_j	max.	150	°C
Rate of rise of on-state current	$\frac{dI_T}{dt}$	max.	20	A/μs

MECHANICAL DATA

Dimensions in mm

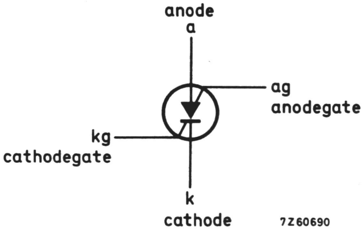
Anodegate connected to case

TO-72


1.16
max
45°
k
kg
1.17
max
a
ag
2.54
5.8
max
4.8
max
0.48
max
5.3
max
12.7min
7Z60778

Accessories supplied on request: 56246; 56263

MEANING OF SYMBOLS


anode
a
ag
anodegate
kg
cathodegate
k
cathode
7Z60690

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

ANODE TO CATHODE

Voltages[1]

Continuous voltages	$V_D = V_R$	max.	70	V
Repetitive peak voltages	$V_{DRM} = V_{RRM}$	max.	70	V
Non-repetitive peak voltages	$V_{DSM} = V_{RSM}$	max.	70	V

Currents

On-state current (d.c.) up to T_{case} = 85 °C	I_T	max.	250	mA
up to T_{amb} = 25 °C	I_T	max.	175	mA
Repetitive peak on-state current t = 10 µs; δ = 0.01	I_{TRM}	max.	2.5	A
Non-repetitive peak on-state current t = 10 µs; T_j = 150 °C prior to surge	I_{TSM}	max.	3	A
Rate of rise of on-state current after triggering to I_T = 2.5 A	$\frac{dI_T}{dt}$	max.	20	A/µs

CATHODEGATE TO CATHODE

Voltage

Reverse peak voltage	V_{RGKM}	max.	5	V

Current

Forward peak current	I_{FGKM}	max.	100	mA

ANODEGATE TO ANODE

Voltage

Reverse peak voltage	V_{RGAM}	max.	70	V

Current

Forward peak current	I_{FGAM}	max.	100	mA

TEMPERATURES

Storage temperature	T_{stg}	−65 to +200		°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\,j\text{-}a}$	=	0.45	°C/mW
From junction to case	$R_{th\,j\text{-}c}$	=	0.15	°C/mW

---

[1] These ratings apply for zero or negative bias on the cathodegate with respect to the cathode, and when a resistor $R \leq 10\ k\Omega$ is connected between cathodegate and cathode.

CHARACTERISTICS

ANODE TO CATHODE

Voltages

On-state voltage $I_T = 100$ mA; $T_j = 25\ ^oC$	V_T	<	1.4	V
Rate of rise of off-state voltage that will not trigger any device [1]	$\frac{dV_D}{dt}$ [1]			

Currents

Peak reverse current $V_{RM} = 70$ V; $T_j = 25\ ^oC$	I_{RM}	typ. <	1 100	nA nA
$T_j = 150\ ^oC$	I_{RM}	<	2	μA
Peak off-state current $V_{DM} = 70$ V; $T_j = 25\ ^oC$	I_{DM}	typ. <	1 100	nA nA
$T_j = 150\ ^oC$	I_{DM}	<	2	μA
Holding current; $R_{GK} = 10\ k\Omega$; $R_{GA} = 220\ k\Omega$; $T_j = 25\ ^oC$	I_H	<	250	μA

CATHODEGATE TO CATHODE

Voltages

Voltage that will trigger all devices $V_D = 6$ V; $T_j = 25\ ^oC$	V_{GKT}	>	0.5	V

Current

Current that will trigger all devices $V_D = 6$ V; $T_j = 25\ ^oC$	I_{GKT}	>	1	μA

ANODEGATE TO ANODE

Voltages

Voltage that will trigger all devices $V_D = 6$ V; $T_j = 25\ ^oC$	V_{GAT}	>	1	V

Current

Current that will trigger all devices $V_D = 6$ V; $R_{GK} = 10\ k\Omega$; $T_j = 25\ ^oC$	I_{GAT}	>	100	μA

---

1) The dV_D/dt is unlimited when the anodegate lead is returned to the anode supply voltage through a current limiting resistor.

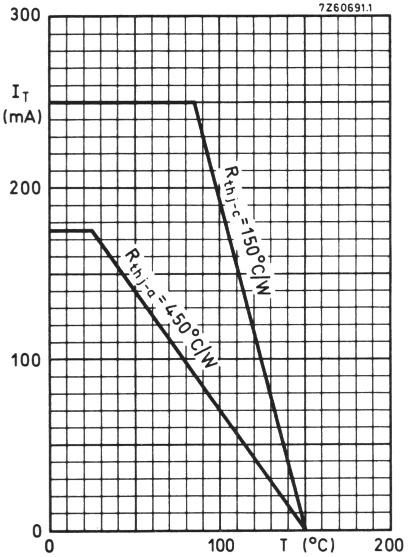
SWITCHING CHARACTERISTICS

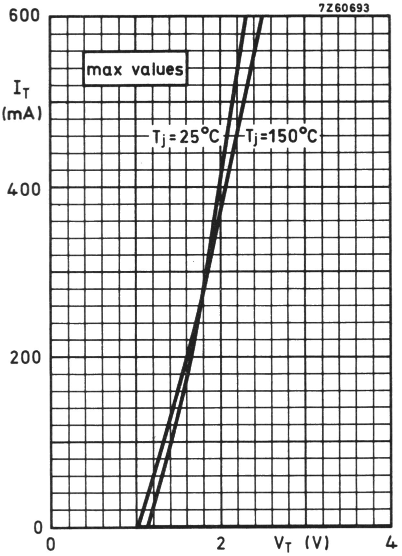
Turn-on time ($t_{on} = t_d + t_r$)

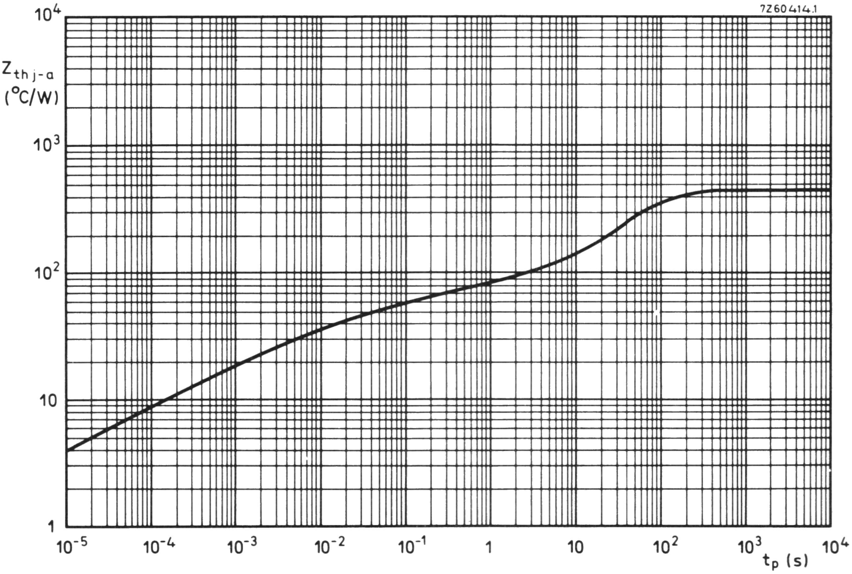
V_D = 15 V; I_T = 150 mA R_{GK} = 10 kΩ; T_j = 25 °C	t_{on}	<	300	ns

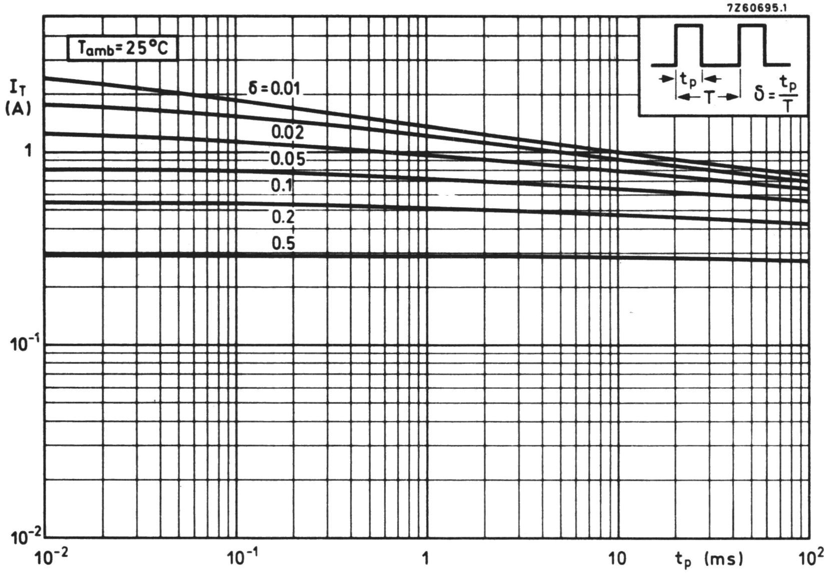
Circuit-commutated turn-off time

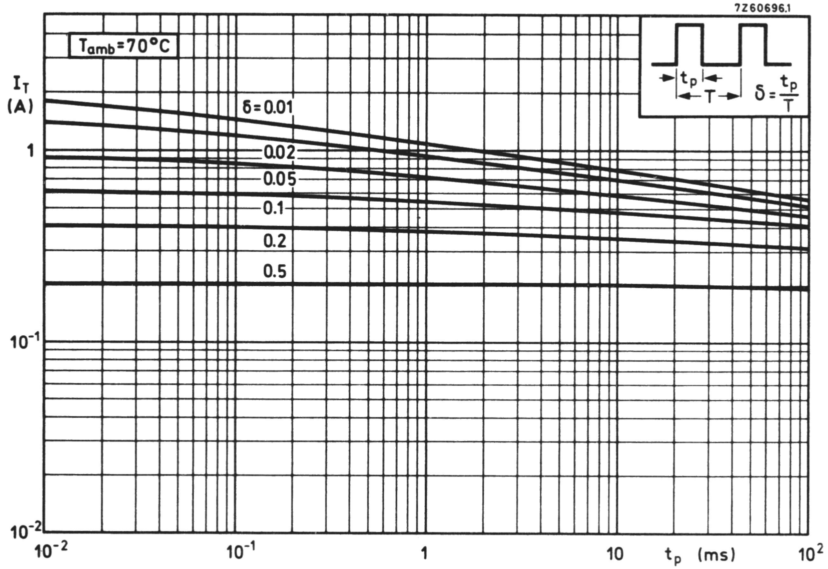
$V_D = V_R$ = 15 V; I_T = 150 mA R_{GK} = 10 kΩ; T_j = 25 °C	t_{off}	<	3	μs

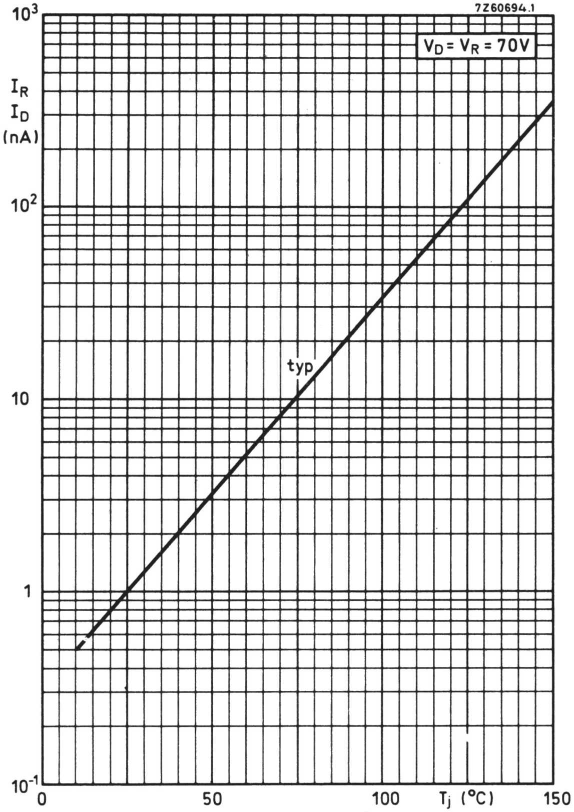

7Z60691.1
300
200
100
0
I_T (mA)
$R_{th\,j-c}$ = 150°C/W
$R_{th\,j-a}$ = 450°C/W
0
100
T (°C)
200


7Z60693
600
400
200
0
I_T (mA)
max values
T_j = 25°C
T_j = 150°C
0
2
V_T (V)
4


7Z60414.1
10^4
10^3
10^2
10
1
$Z_{th\,j-a}$ (°C/W)
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
10^3
10^4
t_p (s)

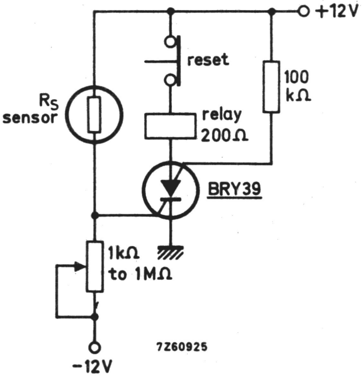

7Z60695.1
T_{amb} = 25 °C
I_T (A)
1
10^{-1}
10^{-2}
δ = 0.01
0.02
0.05
0.1
0.2
0.5
10^{-2}
10^{-1}
1
10
t_p (ms)
10^2
t_p
T
$\delta = \frac{t_p}{T}$


7Z60696.1
T_{amb} = 70 °C
I_T (A)
1
10^{-1}
10^{-2}
δ = 0.01
0.02
0.05
0.1
0.2
0.5
10^{-2}
10^{-1}
1
10
t_p (ms)
10^2
t_p
T
$\delta = \frac{t_p}{T}$


7Z60694.1
$V_D = V_R = 70V$
I_R
I_D
(nA)
10^3
10^2
10
1
10^{-1}
typ
0
50
100
T_j (°C)
150

APPLICATION INFORMATION

Sensing network


+12V
reset
100 kΩ
R_S sensor
relay 200Ω
BRY39
1kΩ to 1MΩ
7Z60925
-12V

R_S must be chosen in accordance with the light, temperature, or radiation intensity to be sensed; its resistance should be of the same order as that of the potentiometer.

In the arrangement shown, a decline in resistance of R_S triggers the thyristor, closing the relay that activates the warning system. If the positions of R_S and the potentiometer are interchanged, an increase in the resistance of R_S triggers the thyristor.

SILICON THYRISTORS

Plastic encapsulated p-gate silicon thyristors, intended for motor control in food mixers, sewing machines and hand drills, and for use in switching, ignition and starting systems. The series consists of the reverse polarity types: BT100A-300R; BT100A-500R.

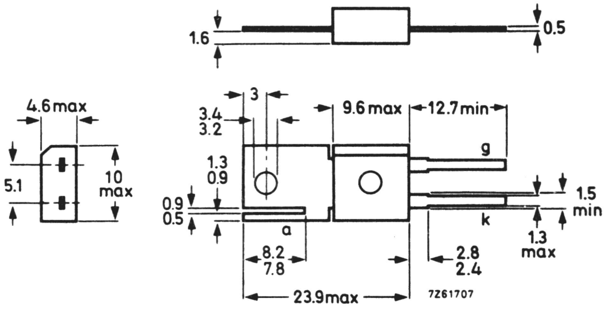
QUICK REFERENCE DATA

			BT100A-300R	500R	
Crest working voltages	$V_{DWM} = V_{RWM}$	max.	200	400	V
Repetitive peak voltages	$V_{DRM} = V_{RRM}$	max.	200	400	V
Average on-state current up to T_{tab}=75 °C	$I_{T(AV)}$	max.	2		A
R.M.S. on-state current	$I_{T(RMS)}$	max.	4.5		A
Non-repetitive peak on-state current t = 10 ms; T_j = 100 °C prior to surge	I_{TSM}	max.	40		A
Junction temperature	T_j	max.	100		°C

MECHANICAL DATA

Dimensions in mm

chamfer to indicate gate lead


1.6
0.5
4.6max
5.1
10 max
3
3.4
3.2
1.3
0.9
9.6 max
12.7min
g
0.9
0.5
a
k
1.5 min
1.3 max
8.2
7.8
2.8
2.4
23.9max
7Z61707

All information applies to frequencies up to 400 Hz.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

ANODE TO CATHODE

Voltages [1]

			BT100A - 300R	500R	
Continuous reverse voltage	V_R	max.	200	400	V
Crest working voltages	$V_{DWM} = V_{RWM}$	max.	200	400	V
Repetitive peak voltages ($\delta \leq 0.01$)	$V_{DRM} = V_{RRM}$	max.	300	500	V
Non-repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	300	500	V
Continuous off-state voltage	V_D	max.	200	400	V
Non-repetitive peak off-state voltage ($t \leq 10$ ms)	V_{DSM}	max.	300	500	V

Currents (for overload conditions see curve on page 6)

Average on-state current (averaged over any 20 ms period) up to $T_{tab} = 75\ ^{o}C$	$I_{T(AV)}$	max.	2	A
On-state current (d.c.)	I_T	max.	4.5	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	4.5	A
Repetitive peak on-state current	I_{TRM}	max.	20	A
Non-repetitive peak on-state current ($t = 10$ ms; half sine wave) $T_j = 100\ ^{o}C$ prior to surge	I_{TSM}	max.	40	A
I squared t for fusing ($t = 10$ ms)	I^2t	max.	8	A^2s
Rate of rise of on-state current after triggering with $I_G = I_{GT}$ to $I_T = 20$ A	$\frac{dI_T}{dt}$	max.	100	A/μs
Starting current		see page 5		

---

[1] To ensure thermal stability: $R_{th\ j-a} < 37.5\ ^{o}C/W$ (d.c. blocking) or $< 60\ ^{o}C/W$ (a.c.)

RATINGS (continued)

GATE TO CATHODE

Voltages				
Forward peak voltage				
Reverse peak voltage	V_{RGM}	max.	5	V
Current				
Forward peak current	I_{FGM}	max.	250	mA
Power dissipation				
Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	100	mW
Peak power dissipation	P_{GM}	max.	1	W

TEMPERATURES

Storage temperature	T_{stg}	-40 to +100		°C
Junction temperature	T_j	max.	100	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	75	°C/W
From junction to tab	$R_{th\ j-tab}$	8	°C/W
From tab to heatsink			
without heatsink compound	$R_{th\ tab-h}$	3	°C/W
with heatsink compound, (e.g. Dow Corning 340)	$R_{th\ tab-h}$	1	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j-tab}$	0.9	°C/W

CHARACTERISTICS

ANODE TO CATHODE

			BT100A - 300R	500R	
Voltages					
On-state voltage $I_T = 5$ A; $T_j = 25$ °C	V_T	<	1.4	1.4	V[1]
Rate of rise of off-state voltage that will not trigger any device; $T_j = 100$ °C	$\frac{dV_D}{dt}$	<	10	10	V/µs
Currents					
Peak reverse current at $T_j = 100$ °C $V_{RM} = V_{RWMmax}$	I_{RM}	<	2	1	mA
Peak off-state current at $T_j = 100$ °C $V_{DM} = V_{DWMmax}$	I_{DM}	<	2	1	mA
Latching current; $T_j = 25$ °C	I_L	typ.	10	10	mA
		<	40	40	mA
Holding current; $T_j = 25$ °C	I_H	typ.	4	4	mA
		<	15	15	mA

---

1) Measured under pulsed conditions to avoid excessive dissipation.

CHARACTERISTIC (continued)

GATE TO CATHODE

Voltages

Voltage that will trigger all devices

$V_D = 6$ V; $T_j = 25$ °C	V_{GT}	>	2	V
$V_D = 6$ V; $T_j = -40$ °C	V_{GT}	>	2.5	V

Voltage that will not trigger any device

$V_D = V_{DRMmax}$; $T_j = 100$ °C	V_{GD}	<	0.20	V

Current

Current that will trigger all devices

$V_D = 6$ V; $T_j = 25$ °C	I_{GT}	>	10	mA
$V_D = 6$ V; $T_j = -40$ °C	I_{GT}	>	15	mA

SWITCHING CHARACTERISTICS

Turn-on time when switched from

$V_D = V_{DWMmax}$ to $I_T = 3$ A Gate source 5 V; 100 Ω; $T_j = 25$ °C	t_{on}	typ.	1.3	μs

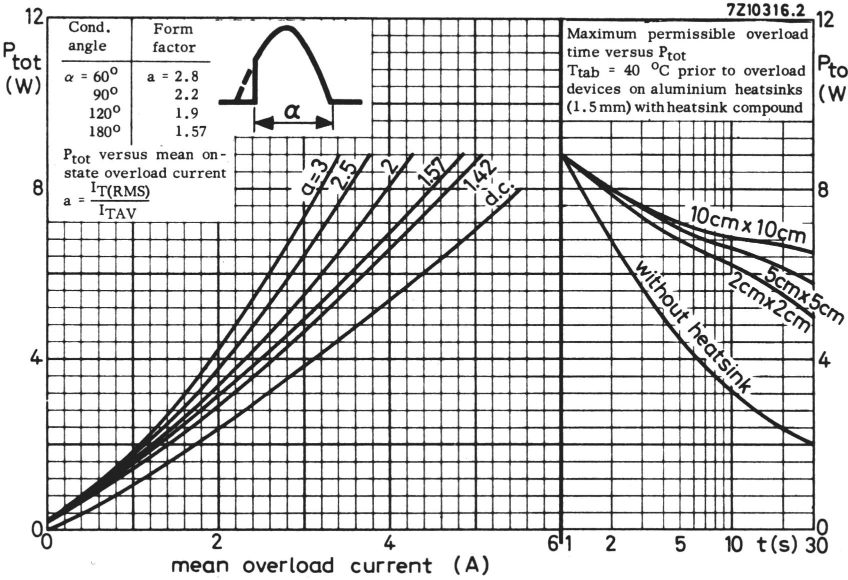
Turn-off time when switched from

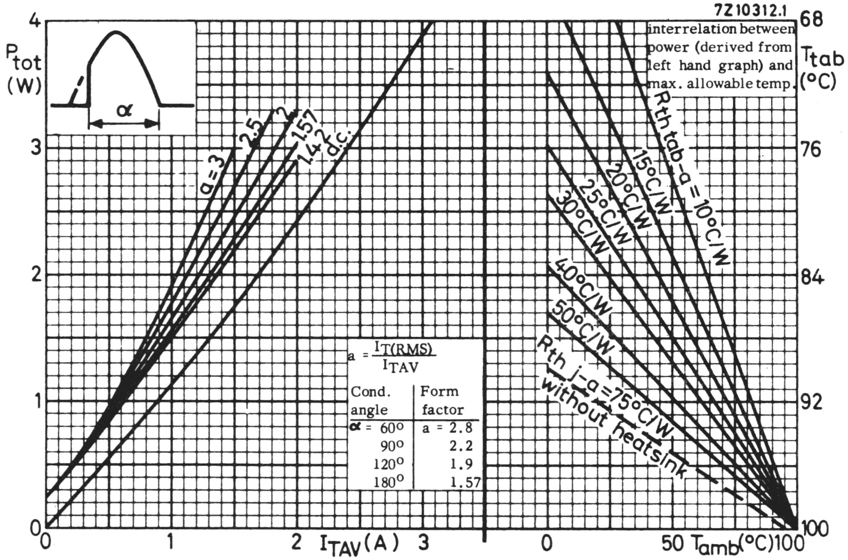
$I_T = 1$ A; $\frac{dV_D}{dt} = 10$ V/μs; $T_j = 25$ °C	t_q	typ.	10	μs

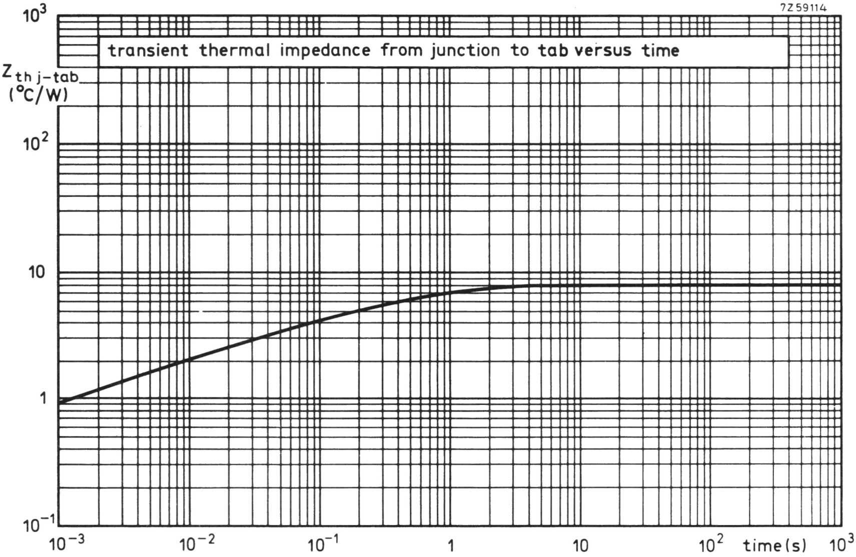
OPERATING NOTES

1. The thyristors may be soldered directly into the circuit but a thermal shunt should be used to keep heat conduction to the junction to a minimum.
2. Overload conditions

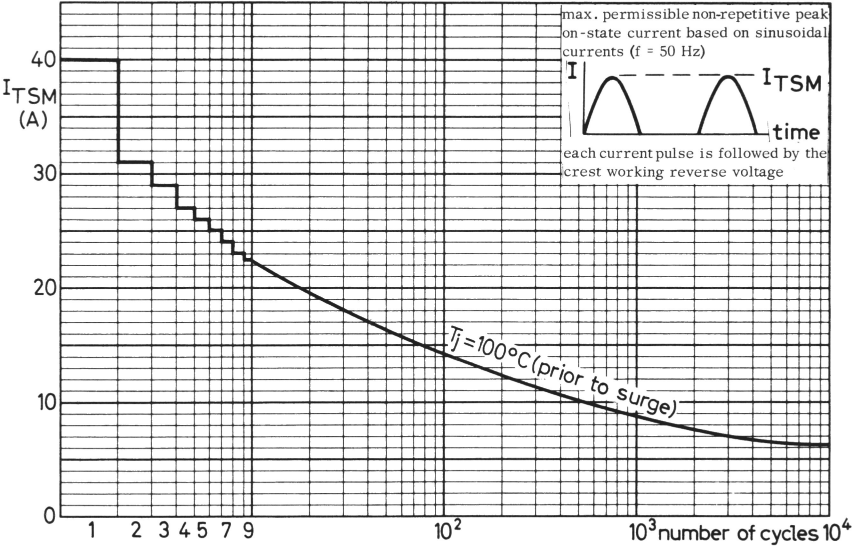
   The method of using the graph below is as follows:
   Starting with the curves of dissipation versus mean on-state overload current, for a particular current value trace upwards to meet the appropriate form factor curve. Then trace horizontally until the appropriate heatsink curve is reached. Finally trace downwards to determine the permitted overload time. After the permitted overload time the device must revert to normal operations as derived from the graph on page 6.




7Z10312.1
P_{tot} (W)
4
3
2
1
0
α
a=3
2.5
2
1.57
1.42
d.c.
$a = \frac{I_{T(RMS)}}{I_{TAV}}$
Cond. angle | Form factor
α = 60° | a = 2.8
90° | 2.2
120° | 1.9
180° | 1.57
0
1
2
I_{TAV} (A)
3
interrelation between power (derived from left hand graph) and max. allowable temp.
T_{tab} (°C)
68
76
84
92
100
Rth tab-a = 10°C/W
15°C/W
20°C/W
25°C/W
30°C/W
40°C/W
50°C/W
Rth j-a = 75°C/W without heatsink
0
50
T_{amb} (°C)
100


7Z59114
transient thermal impedance from junction to tab versus time
$Z_{th\ j-tab}$ (°C/W)
10^3
10^2
10
1
10^{-1}
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
time (s)
10^3

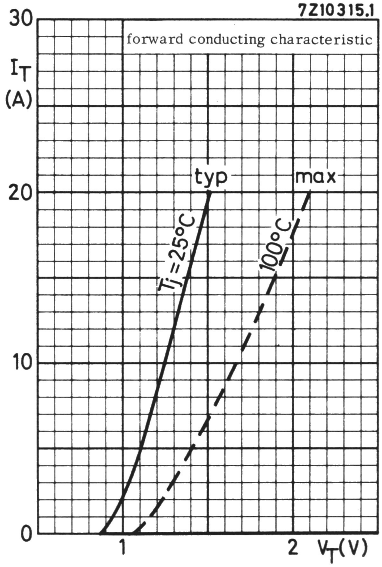
7Z10313



max. permissible non-repetitive peak on-state current based on sinusoidal currents (f = 50 Hz)

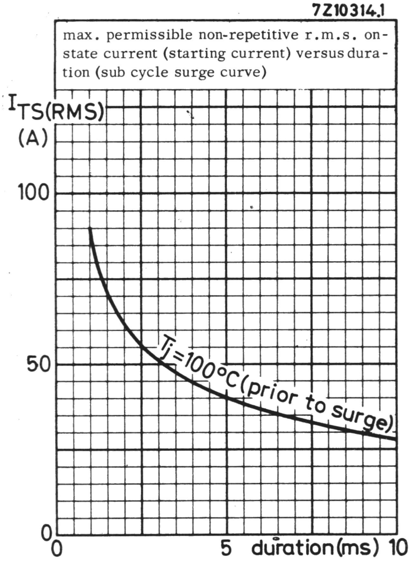
each current pulse is followed by the crest working reverse voltage

7Z10315.1



forward conducting characteristic

7Z10314.1



max. permissible non-repetitive r.m.s. on-state current (starting current) versus duration (sub cycle surge curve)

SILICON THYRISTORS

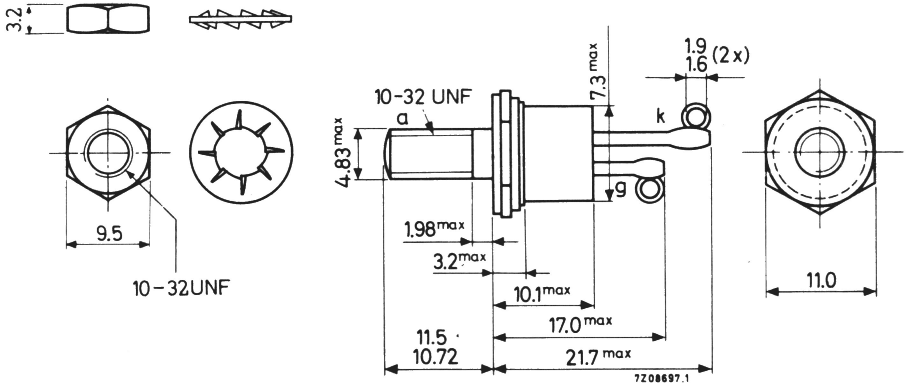
P-gate silicon thyristors in a TO-64 metal envelope, intended for use in domestic applications. The series consist of the reverse polarity types (stud-anode) BT101-300R; BT101-500R; BT102-300R and BT102-500R.
The BT101series has a higher triggering sensitivity.

QUICK REFERENCE DATA

			BT101; BT102-300R	500R	
Crest working reverse voltage	V_{RWM}	max.	200	400	V
Crest working off-state voltage	V_{DWM}	max.	200	400	V
Average on-state current (T_{mb} = 85 °C)	I_{TAV}	max.	6.5		A
R.M.S. on-state current	$I_{T(RMS)}$	max.	15		A
Non repetitive peak on-state current(t=10 ms)	I_{TSM}	max.	55		A
Junction temperature	T_j	max.	125		°C
Current to trigger all devices V_D = 6 V; T_j = 25 °C	BT101 I_{GT}	>	10		mA
	BT102 I_{GT}	>	50		mA

MECHANICAL DATA Dimensions in mm

TO-64


3.2
9.5
10-32UNF
10-32 UNF
a
4.83 max
7.3 max
1.9
1.6 (2 x)
k
g
1.98 max
3.2 max
10.1 max
17.0 max
11.5
10.72
21.7 max
11.0
7Z08697.1

Diameter of hole in heatsink: max. 5.2 mm
Accessories available: 56295, (56262A)

Torque on nut: min. 9 cmkg
max. 17 cmkg

All information applies to frequencies up to 400 Hz.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

ANODE TO CATHODE

Voltages 1)

			BT101; BT102-300R	500R	
Crest working reverse voltage	V_{RWM}	max.	200	400	V
Repetitive peak reverse voltage ($\delta \leq 0.01$; f = 50 Hz)	V_{RRM}	max.	300	500	V
Non repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	300	500	V
Crest working off-state voltage	V_{DWM}	max.	200	400	V
Repetitive peak off-state voltage ($\delta \leq 0.01$; f = 50 Hz)	V_{DRM}	max.	300	500	V
Non repetitive peak off-state voltage ($t \leq 10$ ms)	V_{DSM}	max.	300	500	V

Currents (for overload conditions see curve on page 8)

Average on-state current (averaged over any 20 ms period) T_{mb} = 85 °C	I_{TAV}	max.	6.5	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	15	A
Repetitive peak on-state current	I_{TRM}	max.	50	A
Non repetitive peak on-state current (t = 10 ms) (see also page 7)	I_{TSM}	max.	55	A
I squared t for fusing ($t \leq 10$ ms)	I^2t	max.	15	A^2s
Rate of rise of on-state current	$\frac{dI_T}{dt}$	max.	50	A/μs
Starting current		see page 7		

GATE TO CATHODE

Voltages

Forward peak voltage	V_{FGM}	max.	10	V
Reverse peak voltage	V_{RGM}	max.	5	V

Current

Forward peak current	I_{FGM}	max.	2	A

Power dissipation

Average power dissipation (averaged over any 20 ms period)	P_{GAV}	max.	0.5	W
Peak power dissipation	P_{GM}	max.	5	W

---

1) These ratings apply to a gate voltage range of −5 to +0.25 V.
To ensure thermal stability: $R_{th\ j-a} \leq 20$ °C/W (d.c.) or ≤ 40 °C/W (a.c.).

RATINGS (continued)

Temperatures

Storage temperature	T_{stg}		−55 to +125	°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	3	°C/W
From junction to ambient in free air with nut and washer	$R_{th\ j\text{-}a}$	=	40	°C/W
From mounting base to heatsink for a torque of 9 kg cm on the nut	$R_{th\ mb\text{-}h}$	=	0.5	°C/W

CHARACTERISTICS

T_j = 125 °C unless otherwise specified

ANODE TO CATHODE

Voltage

On-state voltage $I_T = 20$ A; $T_j = 25$ °C	V_T	<	2.3	V [1]

Currents

Reverse current $V_R = V_{RWMmax}$	I_R	<	1.5	mA
Off-state current $V_D = V_{DWMmax}$	I_D	<	1.5	mA

GATE TO CATHODE

Voltages

			BT101	BT102	
Voltage to trigger all devices					
$V_D = 6$ V; $T_j = +25$ °C	V_{GT}	>	2	2.5	V
$V_D = 6$ V; $T_j = -10$ °C	V_{GT}	>	2.1	2.8	V
Voltage not to trigger any device	V_{GD}	<	0.25		V

Current

			BT101	BT102	
Current to trigger all devices					
$V_D = 6$ V; $T_j = +25$ °C	I_{GT}	>	10	50	mA
$V_D = 6$ V; $T_j = -10$ °C	I_{GT}	>	13	65	mA

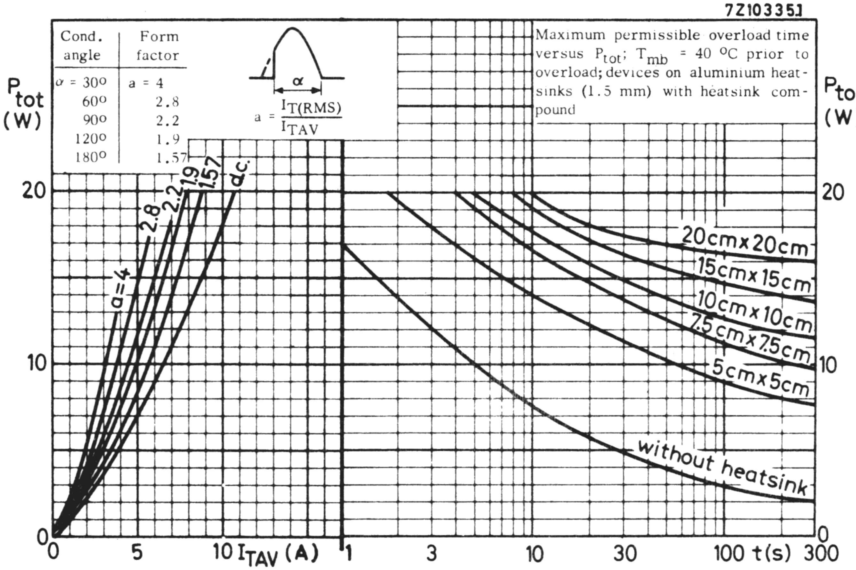
---

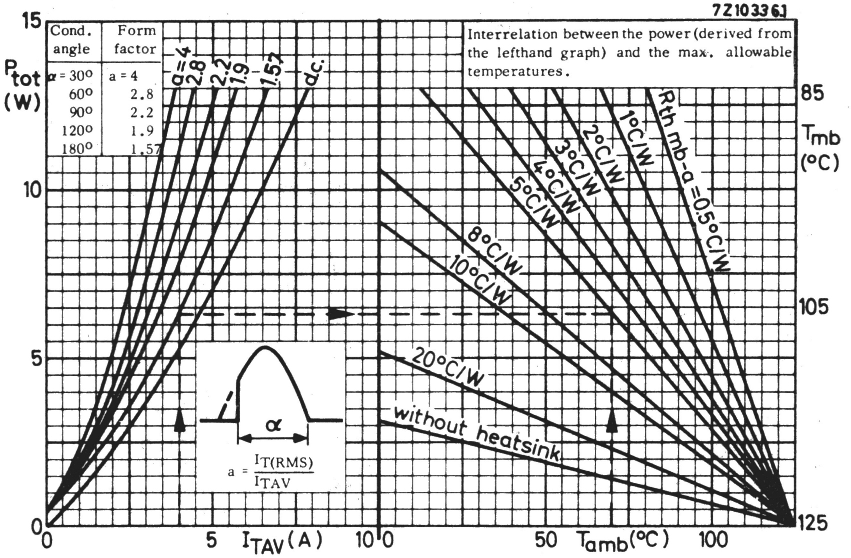
[1]) Measured under pulsed conditions to prevent excessive dissipation.

OPERATING NOTES (See also general pages at the beginning of this section)

1. The gate and cathode connectors should not be bent or twisted; they should be soldered into the circuit so that there is no strain on them.
   During soldering the heat conduction to the junction should be kept to a minimum by using a thermal shunt.
2. Overload conditions

   The method of using the graph below is as follows:
   Starting with the curves of dissipation versus mean on-state overload current, for a particular current value trace upwards to meet the appropriate form factor curve. Then trace horizontally until the appropriate heatsink curve is reached. Finally trace downwards to determine the permitted overload time. After the permitted overload time the device must revert to normal operation as derived from the graph on page 5.





Determination of the heatsink thermal resistance.

Example:

Assume a thyristor, used in a single phase rectifier circuit.

conduction angle	α	=	180°	
average forward current	I_{TAV}	=	4	A
ambient temperature	T_{amb}	=	70	°C

From the left hand part of the graph above it follows that at I_{TAV} = 4 A and α = 180° in a single phase rectifier circuit the average forward power + average leakage power = 6.4 W.

From the right hand part of the graph above follows the thermal resistance, required for P_{tot} = 6.4 W at T_{amb} = 70 °C

$$R_{th\ mb-a} \approx 5 \quad {}^{o}C/W$$

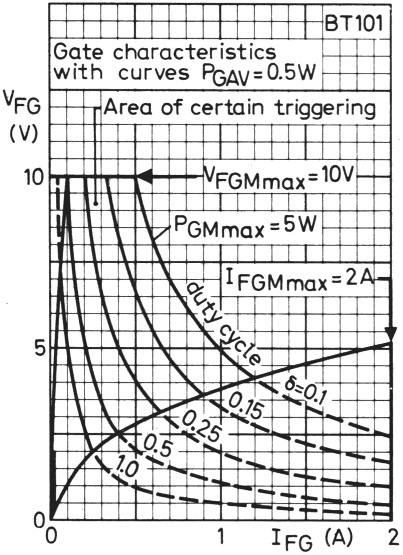
The contact thermal resistance $R_{th\ mb-h}$ = 0.5 °C/W

Hence the heatsink thermal resistance should be:

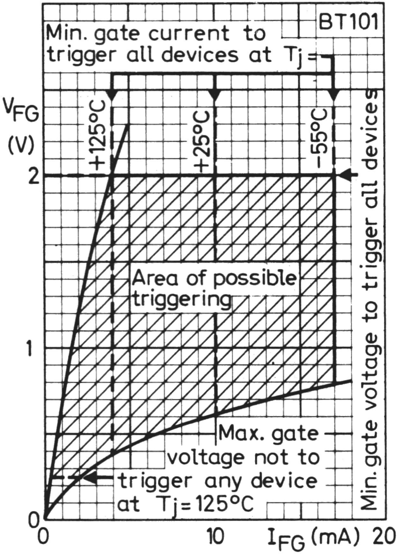
$$R_{th\ h-a} = R_{th\ mb-a} - R_{th\ mb-h} = (5 - 0.5)\ {}^{o}C/W = 4.5\ {}^{o}C/W$$

The applicable heatsink(s) may then be found in the section HEATSINKS.

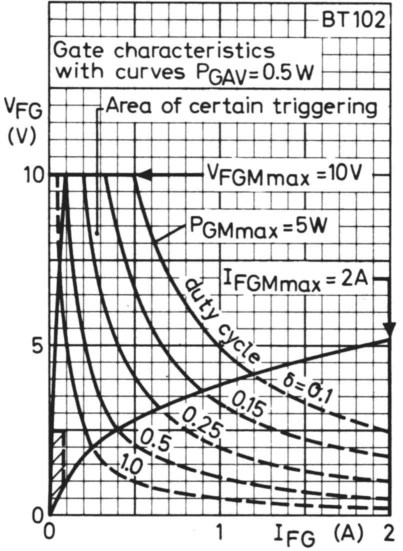
7Z09021



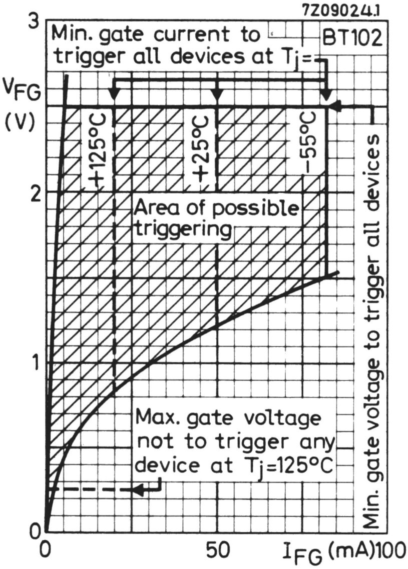
7Z090221

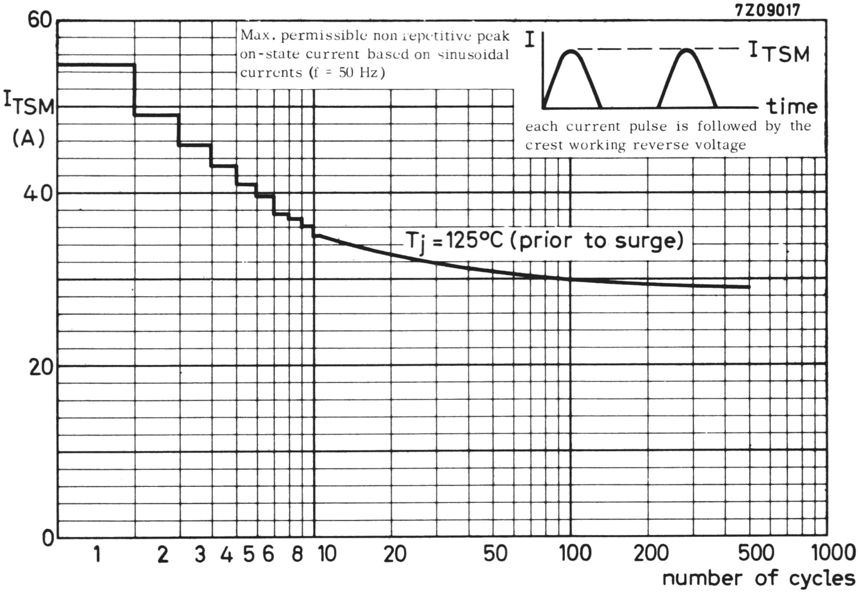


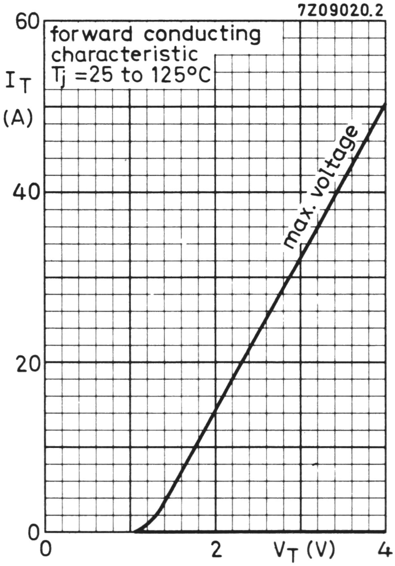
7Z09023

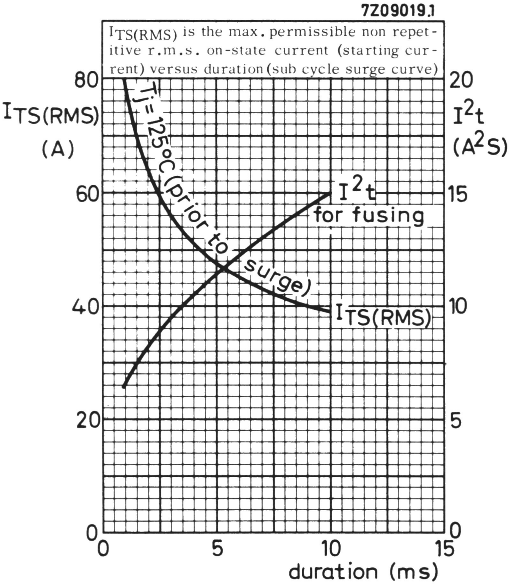


7Z090241




7Z09017
Max. permissible non repetitive peak on-state current based on sinusoidal currents (f = 50 Hz)
I
ITSM
time
each current pulse is followed by the crest working reverse voltage
Tj = 125°C (prior to surge)
ITSM (A)
60
40
20
0
1
2
3
4
5
6
8
10
20
50
100
200
500
1000
number of cycles


7Z09020.2
forward conducting characteristic
Tj = 25 to 125°C
IT (A)
max. voltage
60
40
20
0
0
2
VT (V)
4


7Z09019.1
ITS(RMS) is the max. permissible non repetitive r.m.s. on-state current (starting current) versus duration (sub cycle surge curve)
ITS(RMS) (A)
I²t (A²S)
Tj = 125°C (prior to surge)
I²t for fusing
ITS(RMS)
80
60
40
20
0
20
15
10
5
0
0
5
10
15
duration (ms)

70 A AVALANCHE THYRISTORS

Silicon thyristors in metal envelopes, with avalanche properties.
A version with guaranteed values of avalanche voltage and avalanche power can be supplied on request.
BTW23 series -M has metric thread, BTW23series -U UNF thread. Both series consist of reverse polarity types (anode to stud) identified by a suffix R:
BTW23-600RM to 1600RM and BTW23-600RU to 1600RU.

QUICK REFERENCE DATA

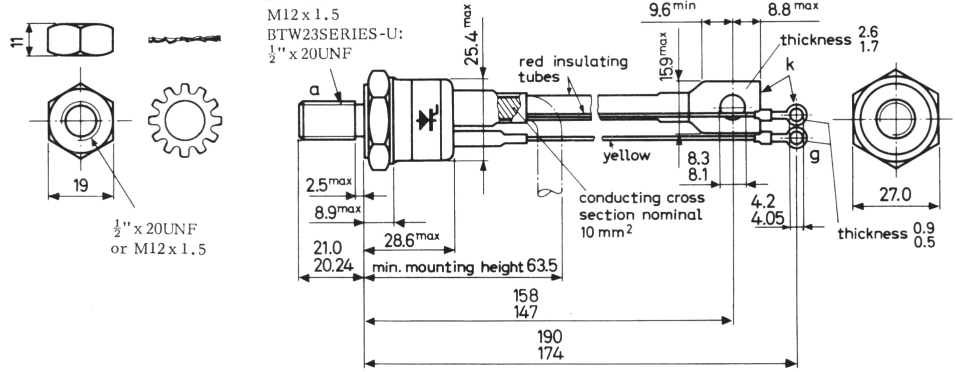
		BTW23-600RM BTW23-600RU	800RM 800RU	1000RM 1000RU	1200RM 1200RU	1400RM 1400RU	1600RM 1600RU	
Repetitive peak voltages $V_{DRM} = V_{RRM}$	max.	600	800	1000	1200	1400	1600	V
Crest working voltages $V_{DWM} = V_{RWM}$	max.	600	800	1000	1200	1200	1200	V
Forward breakover voltage $V_{(BO)}$	>	700	900	1100	1300	1400	1600	V

Average on-state current up to $T_{mb} = 85\,^{o}C$	$I_{T(AV)}$	max.	70	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	110	A
Non-repetitive peak on-state current $t = 10\,ms$; $T_j = 125\,^{o}C$ prior to surge	I_{TSM}	max.	1500	A
Junction temperature	T_j	max.	125	^{o}C
Rate of rise of on-state current after triggering	$\frac{dI_T}{dt}$	max.	300	A/μs
Rate of rise of off-state voltage that will not trigger any device	$\frac{dV_D}{dt}$	<	200	V/μs

MECHANICAL DATA see page 2

MECHANICAL DATA

Dimensions in mm


11
19
½" x 20UNF
or M12 x 1.5
BTW23SERIES-M:
M12 x 1.5
BTW23SERIES-U:
½" x 20UNF
a
25.4 max
red insulating tubes
15.9 max
9.6 min
8.8 max
thickness 2.6 1.7
k
yellow
8.3 8.1
g
27.0
2.5 max
8.9 max
28.6 max
21.0 20.24
min. mounting height 63.5
conducting cross section nominal 10 mm²
4.2 4.05
thickness 0.9 0.5
158 147
190 174

Torque on nut: min. 90 kg cm
(9 Newton-metres)
max. 175 kg cm
(17.5 Newton-metres)

Net weight: 108 g
Diameter of clearance hole: max. 13.0 mm

All information applies to frequencies up to 400 Hz.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

ANODE TO CATHODE		BTW23-600RM BTW23-600RU	800RM 800RU	1000RM 1000RU	1200RM 1200RU	1400RM 1400RU	1600RM 1600RU	
Voltages 1)								
Non-repetitive peak voltages ($t \leq 10$ ms) V_{DSM} 2) = V_{RSM}	max.	700	900	1100	1300	1400	1600	V
Repetitive peak voltages ($\delta \leq 0.01$) $V_{DRM} = V_{RRM}$	max.	600	800	1000	1200	1400	1600	V
Crest working voltages $V_{DWM} = V_{RWM}$	max.	600	800	1000	1200	1200	1200	V
Continuous voltages $V_D = V_R$	max.	600	800	1000	1200	1200	1200	V

---

1) To ensure thermal stability: $R_{th\ j\text{-}a} < 0.75\ ^{\circ}C/W$ (d.c. blocking) or $< 1.5\ ^{\circ}C/W$ (a.c.). For smaller heatsinks T_j max should be derated. For a.c. see page 6.

2) Higher off-state voltages may be applied without damage, but at voltages higher than the minimum forward breakover voltage (p.4) the thyristor may switch into the on-state. The rate of rise of on-state current should not exceed 100 A/µs.

RATINGS (continued)

Currents

Average on-state current (averaged over any 20 ms period) up to T_{mb} = 85 °C	$I_{T(AV)}$	max.	70	A
On-state current (d.c.)	I_T	max.	110	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	110	A
Repetitive peak on-state current	I_{TRM}	max.	1000	A
Non-repetitive peak on-state current (t = 10 ms; half sine wave) T_j = 125 °C prior to surge	I_{TSM}	max.	1500	A
I^2t for fusing (t = 10 ms)	I^2t	max.	11000	A^2s
Rate of rise of on-state current after triggering with $I_G = I_{GT}$ to $I_T = 3 \times I_{T(AV)}$ dI_G/dt = 1 A/µs (see upper nomogram on page 11)	$\frac{dI_T}{dt}$	max.	300	A/µs
Rate of rise of on-state current after breakover	$\frac{dI_T}{dt}$	max.	100	A/µs
Rate of change of commutation current	see lower nomogram on page 11			

GATE TO CATHODE

Voltage

Reverse peak voltage	V_{RGM}	max.	10	V

Power dissipation

Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	2	W
Peak power dissipation	P_{GM}	max.	10	W

TEMPERATURES

Storage temperature	T_{stg}		− 55 to +125	°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	0.3	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.1	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.015	°C/W

CHARACTERISTICS

ANODE TO CATHODE

Voltages			BTW23-600RM BTW23-600RU	800RM 800RU	1000RM 1000RU	1200RM 1200RU	1400RM 1400RU	1600RM 1600RU	
On-state voltage I_T = 500 A; T_j = 25 °C	V_T	<	2.5	2.5	2.5	2.5	2.5	2.5	V
Forward breakover voltage up to T_j = 125 °C	$V_{(BO)}$	>	700	900	1100	1300	1400	1600	V
Rate of rise of off-state voltage that will not trigger any device; T_j=125°C	$\frac{dV_D}{dt}$	<	200	200	200	200	200	200	V/µs
Currents									
Peak reverse current $V_{RM}=V_{RWMmax}$; T_j=125°C	I_{RM}	<	20	18	15	13	13	13	mA
Peak off-state current $V_{DM}=V_{DWMmax}$; T_j=125°C	I_{DM}	<	20	18	15	13	13	13	mA

Holding current; T_j=25 °C	I_H	<	200	mA

GATE TO CATHODE

Voltages				
Voltage that will trigger all devices V_D = 6 V; T_j = 25 °C	V_{GT}	>	2.5	V
Voltage that will not trigger any device $V_D = V_{DRMmax}$; T_j = 125 °C	V_{GD}	<	250	mV
Current				
Current that will trigger all devices V_D = 6 V; T_j = 25 °C	I_{GT}	>	200	mA

CHARACTERISTICS (continued)

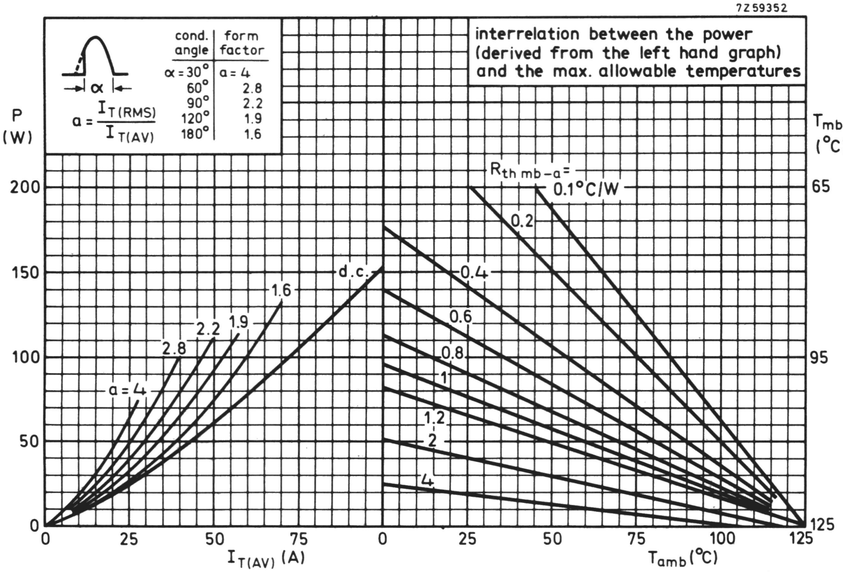
SWITCHING CHARACTERISTICS

Turn-on time ($t_{on} = t_d + t_r$) when switched from $V_D = V_{DWMmax}$ to I_T = 100 A I_{GT} = 200 mA; dI_G/dt = 1 A/µs; T_j = 25 °C	t_{on}	<	2.5	µs
	t_r	typ.	1	µs
Circuit-commutated turn-off time when switched from I_T = 50 A to $V_R \geq$ 50 V with $-dI_T/dt$ = 50 A/µs; dV_D/dt = 200 V/µs; T_j = 125 °C	t_q	typ.	100	µs
	t_q	<	200	µs
T_j = 25 °C	t_q	typ.	60	µs
	t_q	<	120	µs
Spread of reverse recovery charge ($Q_{s\,max} - Q_{s\,min}$) when switched from I_T = 70 A to V_R = 50 V with $-dI_T/dt$ = 10 A/µs; T_j = 125 °C	ΔQ_s	<	50	µC

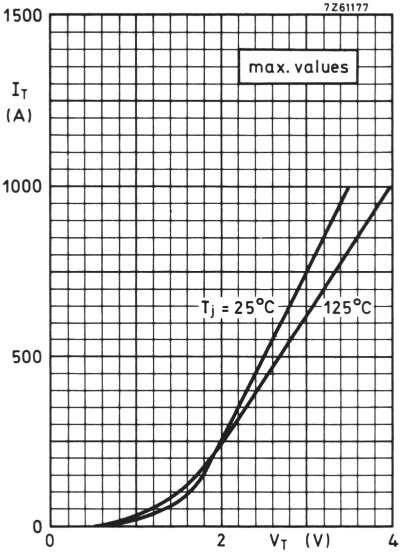
OPERATING NOTES

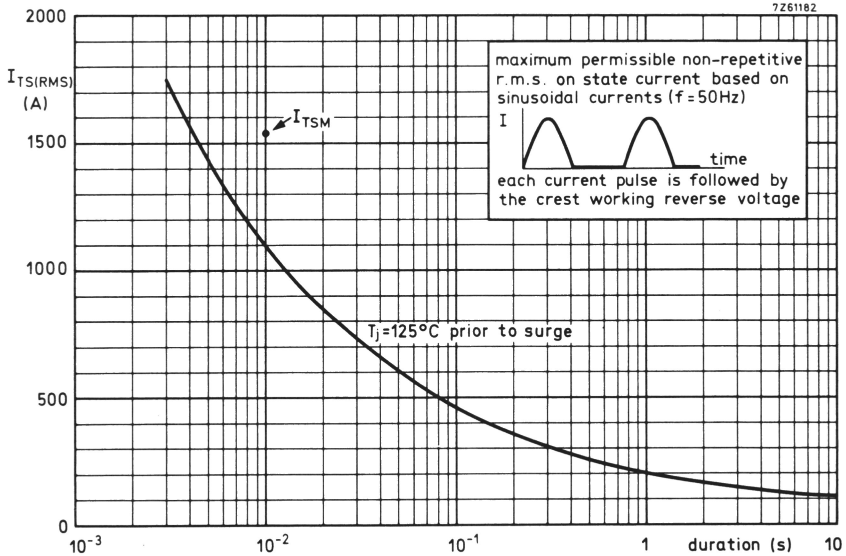
1. Switching losses in commutation

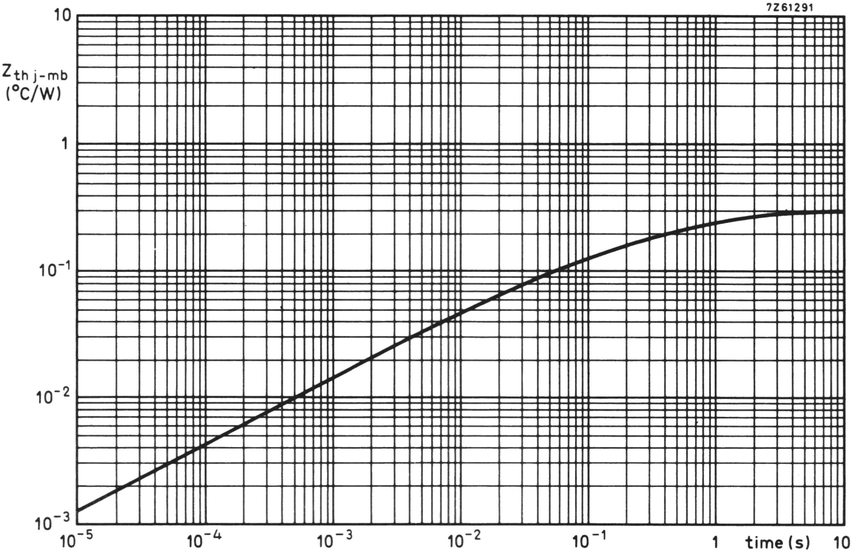
   For applications in which the thyristor is forced to switch from an on-state current I_{TRM} to a high reverse voltage at a high commutation rate ($-dI/dt$), consult the nomogram on page 11 to find the increase in total average power. This increase must be added to the loss from the curves on page 6.

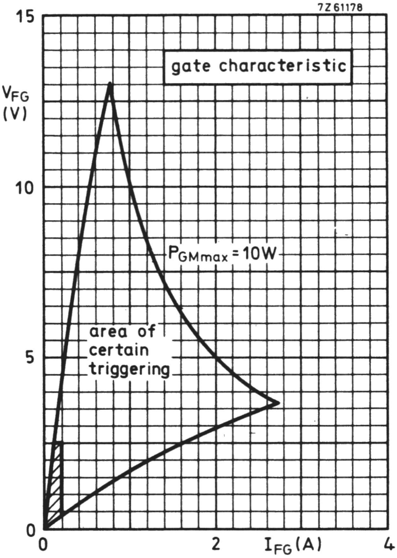


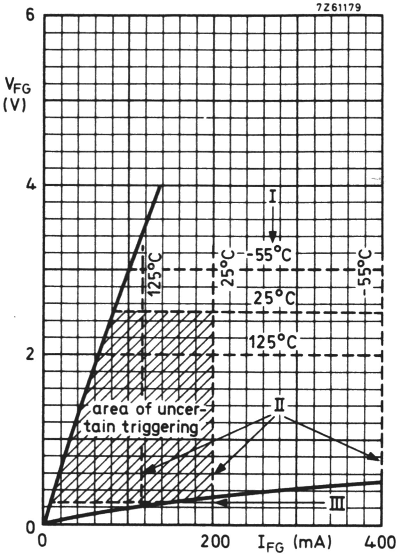
*) T_{mb}–scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leq 1.2$°C/W




7Z61182
$I_{TS(RMS)}$ (A)
2000
1500
1000
500
0
10^{-3}
10^{-2}
10^{-1}
1
duration (s)
10
I_{TSM}
T_j=125°C prior to surge
maximum permissible non-repetitive r.m.s. on state current based on sinusoidal currents (f = 50Hz)
I
time
each current pulse is followed by the crest working reverse voltage


7Z61291
$Z_{th\ j-mb}$ (°C/W)
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
time (s)
10

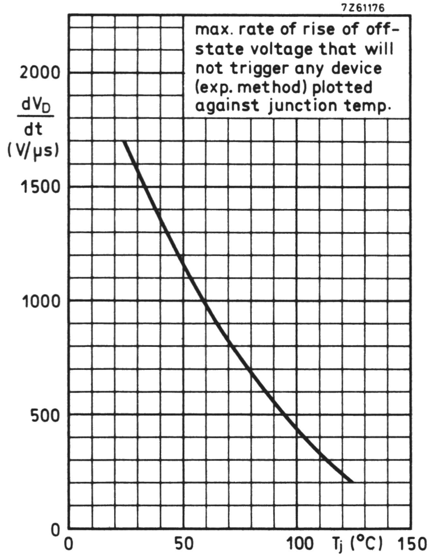


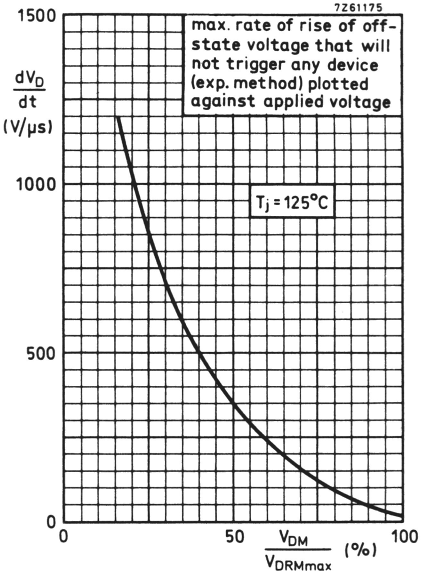


I = minimum gate voltage that will trigger all devices at T_j = ⟶

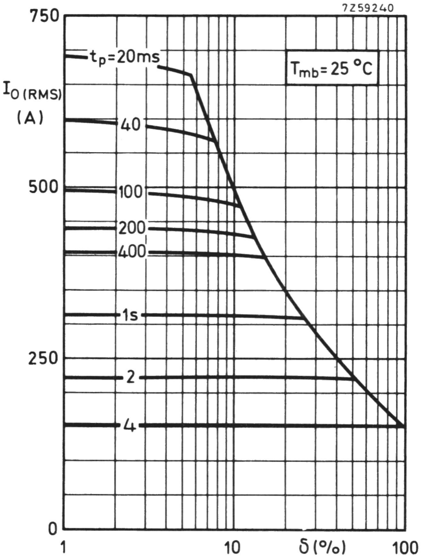
II = minimum gate current that will trigger all devices at T_j = ⟶

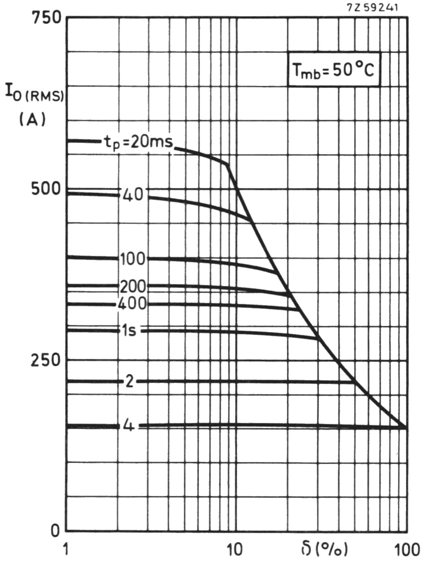
III = maximum gate voltage that will not trigger any device at T_j = ⟶

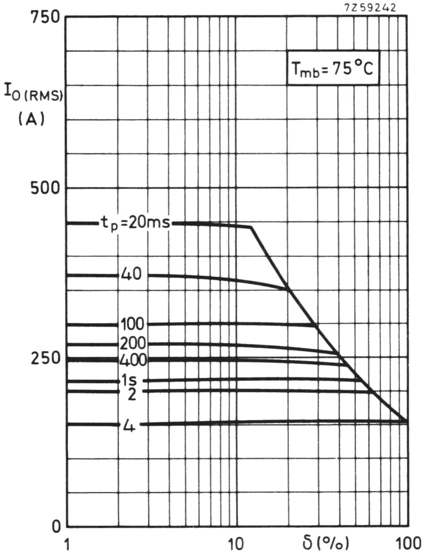

7Z61176
max. rate of rise of off-state voltage that will not trigger any device (exp. method) plotted against junction temp.
$\frac{dV_D}{dt}$ (V/μs)
2000
1500
1000
500
0
0
50
100
T_j (°C)
150

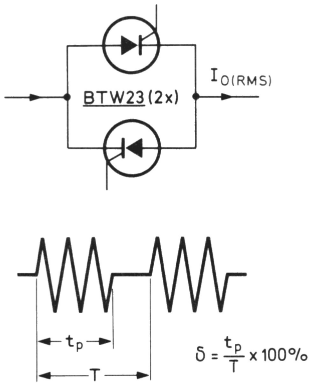

7Z61175
max. rate of rise of off-state voltage that will not trigger any device (exp. method) plotted against applied voltage
$\frac{dV_D}{dt}$ (V/μs)
1500
1000
500
0
$T_j = 125°C$
0
50
100
$\frac{V_{DM}}{V_{DRMmax}}$ (%)

Intermittent overload capability of two BTW23 thyristors in antiparallel connection in a single phase a.c. control circuit (e.g. welding).

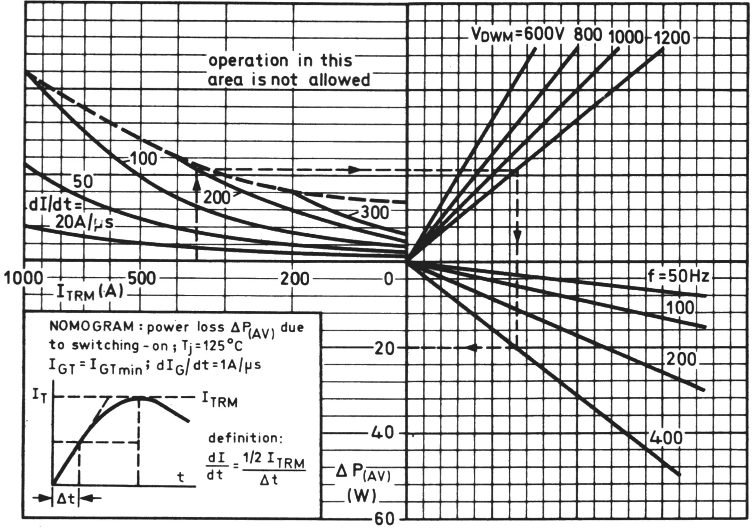






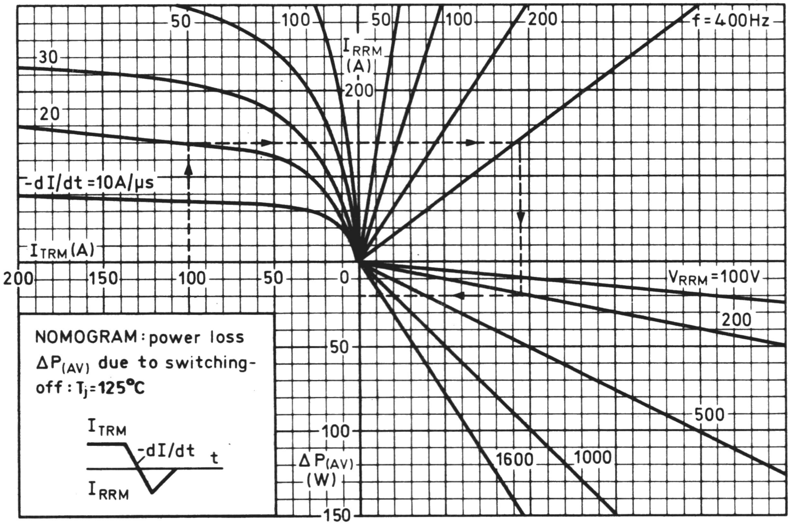


$$\delta = \frac{t_p}{T} \times 100\%$$


7Z61181.1

NOMOGRAM : power loss $\Delta P_{(AV)}$ due to switching - on ; $T_j = 125°C$
$I_{GT} = I_{GTmin}$; $dI_G/dt = 1A/\mu s$

definition: $\frac{dI}{dt} = \frac{1/2\ I_{TRM}}{\Delta t}$


7Z61180

NOMOGRAM : power loss $\Delta P_{(AV)}$ due to switching-off : $T_j = 125°C$

30A AVALANCHE THYRISTORS

Silicon thyristors in metal envelopes, with avalanche properties.
A version with guaranteed values of avalanche voltage and avalanche power can be supplied on request.
BTW24 series-M has metric thread, BTW24 series-U UNF thread. Both series consist of reverse polarity types (anode to stud) identified by a suffix R:
BTW24-600RM to 1600RM and BTW24-600RU to 1600RU.

QUICK REFERENCE DATA

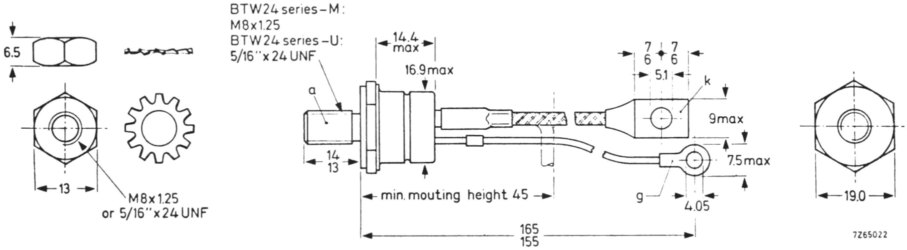
		BTW24-600RM	800RM	1000RM	1200RM	1400RM	1600RM	
		BTW24-600RU	800RU	1000RU	1200RU	1400RU	1600RU	
Repetitive peak voltages $V_{DRM} = V_{RRM}$	max.	600	800	1000	1200	1400	1600	V
Crest working voltages $V_{DWM} = V_{RWM}$	max.	600	800	1000	1200	1200	1200	V
Forward breakover voltage $V_{(BO)}$	>	700	900	1100	1300	1400	1600	V

Average on-state current up to T_{mb} = 85 °C	$I_{T(AV)}$	max.	30	A
at T_{mb} = 75 °C	$I_{T(AV)}$	max.	35	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	50	A
Non-repetitive peak on-state current t = 10 ms; T_j = 125 °C prior to surge	I_{TSM}	max.	600	A
Junction temperature	T_j	max.	125	°C
Rate of rise of on-state current after triggering	$\frac{dI_T}{dt}$	max.	300	A/µs
Rate of rise of off-state voltage that will not trigger any device	$\frac{dV_D}{dt}$	<	200	V/µs

MECHANICAL DATA see page 2

MECHANICAL DATA

Dimensions in mm


6.5
13
M8x1.25
or 5/16"x24 UNF
BTW24 series-M:
M8x1.25
BTW24 series-U:
5/16"x24 UNF
a
14.4 max
16.9max
14
13
min. mouting height 45
165
155
7
6
7
6
5.1
k
9max
7.5max
g
4.05
19.0
7Z65022

All information applies to frequencies up to 400 Hz.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

ANODE TO CATHODE		BTW24-600RM	800RM	1000RM	1200RM	1400RM	1600RM	
		BTW24-600RU	800RU	1000RU	1200RU	1400RU	1600RU	
Voltages [1]								
Non-repetitive peak voltages ($t \leq 10$ ms) V_{DSM} [2] = V_{RSM}	max.	700	900	1100	1300	1400	1600	V
Repetitive peak voltages ($\delta \leq 0.01$) $V_{DRM} = V_{RRM}$	max.	600	800	1000	1200	1400	1600	V
Crest working voltages $V_{DWM} = V_{RWM}$	max.	600	800	1000	1200	1200	1200	V
Continuous voltages $V_D = V_R$	max.	600	800	1000	1200	1200	1200	V

---

[1] To ensure thermal stability: $R_{th\ j-a} < 1$ °C/W (d.c. blocking) or < 2 °C/W (a.c.). For smaller heatsinks $T_j$max should be derated. For a.c. see page 6.

[2] Higher off-state voltages may be applied without damage, but at voltages higher than the minimum forward breakover voltage (p. 4) the thyristor may switch into the on-state. The rate of rise of on-state current should not exceed 100 A/μs.

RATINGS (continued)

Currents

Average on-state current (averaged over any 20 ms period) up to T_{mb} = 85 °C	$I_{T(AV)}$	max.	30	A
at T_{mb} = 75 °C	$I_{T(AV)}$	max.	35	A
On-state current (d.c.)	I_T	max.	50	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	50	A
Repetitive peak on-state current	I_{TRM}	max.	400	A
Non-repetitive peak on-state current (t = 10 ms; half sine wave) T_j = 125 °C prior to surge	I_{TSM}	max.	600	A
I^2t for fusing (t = 10 ms)	I^2t	max.	1800	A^2s
Rate of rise of on-state current after triggering with $I_G = I_{GT}$ to $I_T = 3 \times I_{T(AV)}$ dI_G/dt = 1 A/µs (see nomogram on page 9)	$\frac{dI_T}{dt}$	max.	300	A/µs
Rate of rise of on-state current after breakover	$\frac{dI_T}{dt}$	max.	100	A/µs

GATE TO CATHODE

Voltage

Reverse peak voltage	V_{RGM}	max.	10	V

Power dissipation

Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	1	W
Peak power dissipation	P_{GM}	max.	5	W

TEMPERATURES

Storage temperature	T_{stg}	−55 to +125		°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	0.6	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.2	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.04	°C/W

CHARACTERISTICS

ANODE TO CATHODE

Voltages		BTW24-600RM BTW24-600RU	800RM 800RU	1000RM 1000RU	1200RM 1200RU	1400RM 1400RU	1600RM 1600RU
On-state voltage $I_T = 100$ A; $T_j = 25$ °C	V_T	< 2.1	2.1	2.1	2.1	2.1	2.1 V
Forward breakover voltage up to $T_j = 125$ °C	$V_{(BO)}$	> 700	900	1100	1300	1400	1600 V
Rate of rise of off-state voltage that will not trigger any device; $T_j = 125$ °C	$\frac{dV_D}{dt}$	< 200	200	200	200	200	200 V/μs
Currents							
Peak reverse current $V_{RM} = V_{RWMmax}$; $T_j = 125$ °C	I_{RM}	< 18	15	12	10	10	10 mA
Peak off-state current $V_{DM} = V_{DWMmax}$; $T_j = 125$ °C	I_{DM}	< 18	15	12	10	10	10 mA

Holding current; $T_j = 25$ °C	I_H	<	200 mA
Latching current; $T_j = 25$ °C	I_L	<	300 mA

GATE TO CATHODE

Voltages			
Voltage that will trigger all devices $V_D = 6$ V; $T_j = 25$ °C	V_{GT}	>	2.5 V
Voltage that will not trigger any device $V_D = V_{DRMmax}$; $T_j = 125$ °C	V_{GD}	<	200 mV
Current			
Current that will trigger all devices $V_D = 6$ V; $T_j = 25$ °C	I_{GT}	>	150 mA

CHARACTERISTICS (continued)

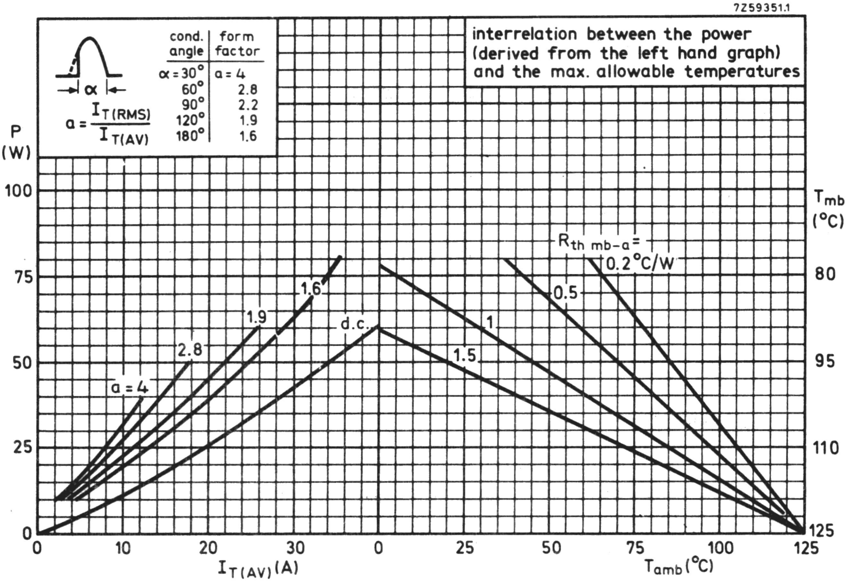
SWITCHING CHARACTERISTICS

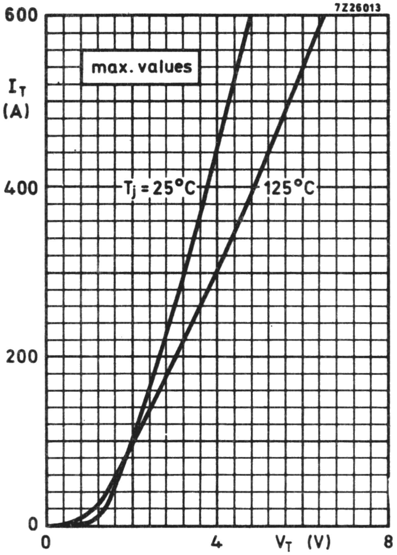
Turn-on time ($t_{on} = t_d + t_r$) when switched from $V_D = V_{DWMmax}$ to $I_T = 100$ A $I_{GT} = 150$ mA; $dI_G/dt = 1$ A/μs; $T_j = 25$ °C	t_{on} t_r	typ. typ.	2 1	μs μs
Circuit-commutated turn-off time when switched from $I_T = 30$ A to $V_R \geq 50$ V with $-dI_T/dt = 30$ A/μs; $dV_D/dt = 100$ V/μs; $T_j = 125$ °C	t_q	typ. <	140 200	μs μs
$T_j = 25$ °C	t_q	<	100	μs

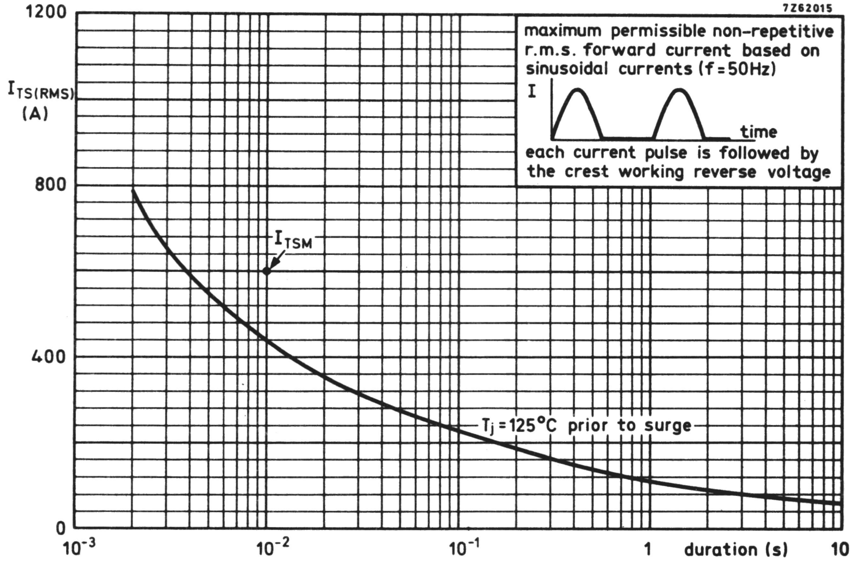
OPERATING NOTES

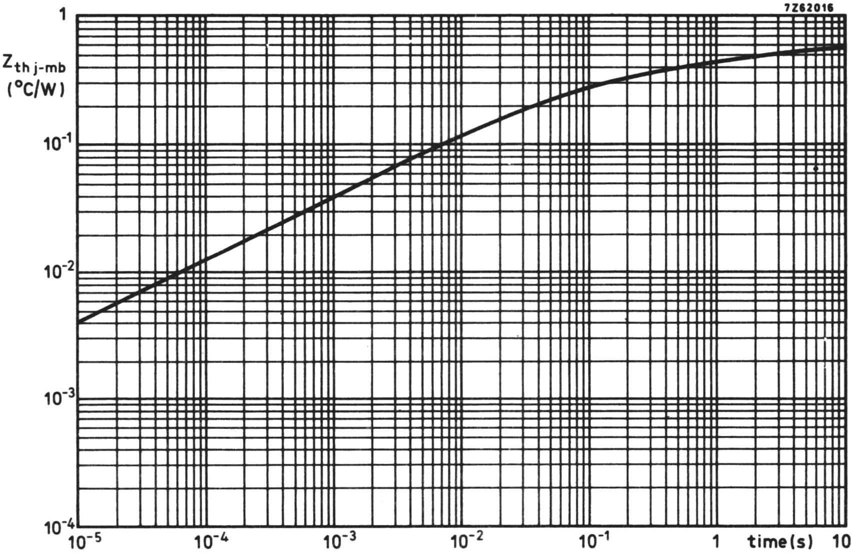
1. Switching losses in commutation

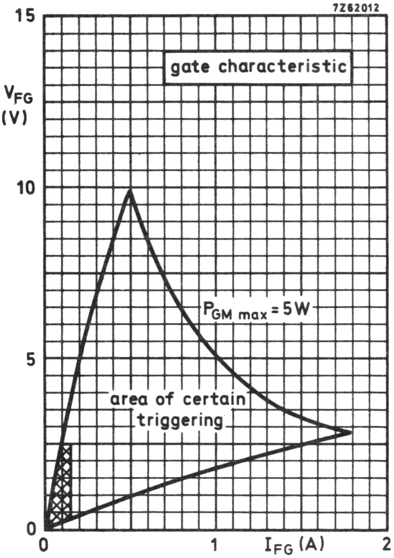
   For applications in which the thyristor is forced to switch from an on-state current I_{TRM} to a high reverse voltage at a high commutation rate ($-dI/dt$), consult the nomogram on page 8 to find the increase in total average power. This increase must be added to the loss from the curves on page 6.

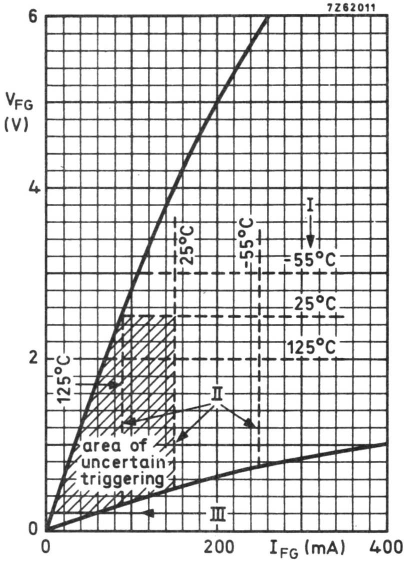

7Z59351.1
cond. angle
form factor
α = 30°
a = 4
60°
2.8
90°
2.2
120°
1.9
180°
1.6
α
a = I_T(RMS) / I_T(AV)
interrelation between the power (derived from the left hand graph) and the max. allowable temperatures
P (W)
100
75
50
25
0
a = 4
2.8
1.9
1.6
d.c.
R_th mb-a = 0.2°C/W
0.5
1
1.5
0
10
20
30
0
25
50
75
100
125
I_T(AV) (A)
T_amb (°C)
T_mb (°C)
80
95
110
125


7Z26013
600
400
200
0
I_T (A)
max. values
T_j = 25°C
125°C
0
4
V_T (V)
8


7Z62015
1200
800
400
0
$I_{TS(RMS)}$
(A)
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50Hz)
I
time
each current pulse is followed by the crest working reverse voltage
I_{TSM}
T_j = 125°C prior to surge
10^{-3}
10^{-2}
10^{-1}
1
duration (s)
10


7Z62016
1
$Z_{th\ j\text{-}mb}$
(°C/W)
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
time(s)
10

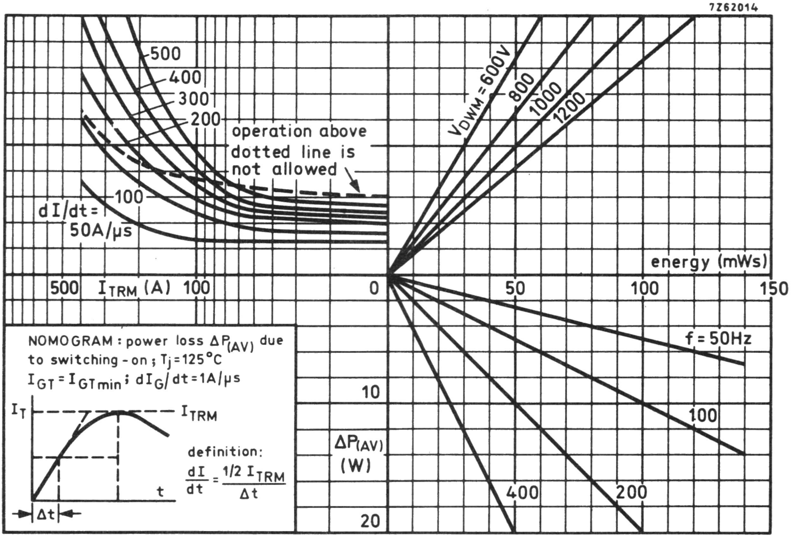


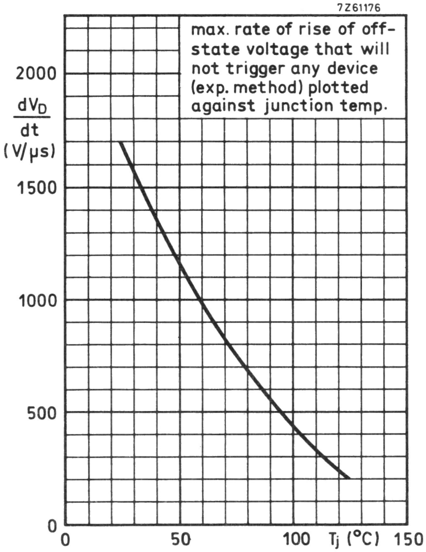


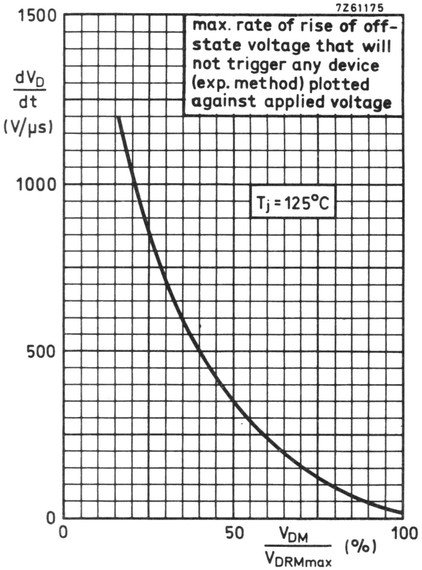
I = minimum gate voltage that will trigger all devices at T_j = →

II = minimum gate current that will trigger all devices at T_j = →

III = maximum gate voltage that will not trigger any devices at T_j = →


7Z62014
500
400
300
200
operation above dotted line is not allowed
100
dI/dt = 50A/μs
500
I_{TRM} (A)
100
0
V_{DWM} = 600V
800
1000
1200
energy (mWs)
50
100
150
NOMOGRAM : power loss $\Delta P_{(AV)}$ due to switching - on ; T_j = 125 °C
$I_{GT} = I_{GTmin}$; dI_G/dt = 1A/μs
I_T
I_{TRM}
definition:
$\frac{dI}{dt} = \frac{1/2\ I_{TRM}}{\Delta t}$
t
Δt
f = 50Hz
10
100
$\Delta P_{(AV)}$ (W)
400
200
20


7Z61176
max. rate of rise of off-state voltage that will not trigger any device (exp. method) plotted against junction temp.
$\frac{dV_D}{dt}$ (V/μs)
2000
1500
1000
500
0
0
50
100
T_j (°C)
150


7Z61175
max. rate of rise of off-state voltage that will not trigger any device (exp. method) plotted against applied voltage
$\frac{dV_D}{dt}$ (V/μs)
1500
1000
500
0
T_j = 125°C
0
50
$\frac{V_{DM}}{V_{DRMmax}}$ (%)
100

FAST TURN-OFF THYRISTORS

The BTW30 series is a range of medium current fast turn-off thyristors in a metal envelope similar to TO-48 with M6 thread. They are intended for use in inverter applications up to frequencies of 35 kHz.
The BTW30 series consists of reverse polarity types (anode to stud) BTW30-300R to 1200R.

QUICK REFERENCE DATA

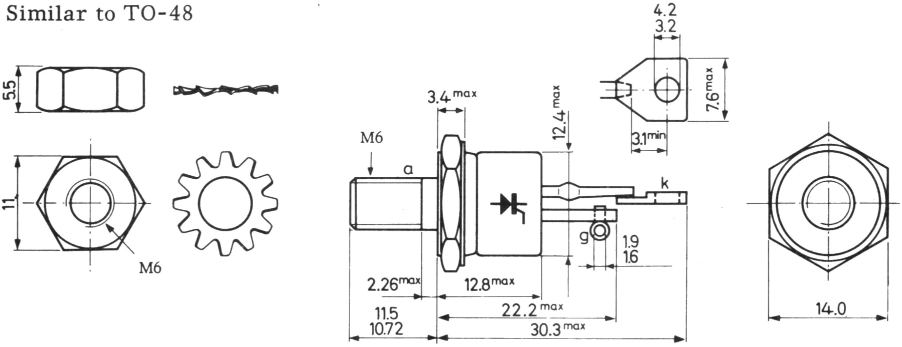
			BTW30-300R	400R	500R	600R	800R	1000R	1200R	
Repetitive peak voltages	$V_{DRM} = V_{RRM}$	max.	300	400	500	600	800	1000	1200	V
Crest working off-state voltage	V_{DWM}	max.	300	400	500	600	600	700	800	V
Forward breakover voltage	$V_{(BO)}$	>	400	500	600	700	900	1100	1300	V

Average on-state current (square wave; $\delta = 0.5$) up to $T_{mb} = 65\ ^{o}C$	$I_{T(AV)}$	max.	16	A
at $T_{mb} = 85\ ^{o}C$	$I_{T(AV)}$	max.	12	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	25	A
Non-repetitive peak on-state current single square pulse; t = 5 ms $T_j = 125\ ^{o}C$ prior to surge	I_{TSM}	max.	150	A
Junction temperature	T_j	max.	125	^{o}C
Rate of rise of on-state current after triggering	$\frac{dI_T}{dt}$	max.	100	A/µs
Rate of rise of off-state voltage that will not trigger any device	$\frac{dV_D}{dt}$	<	200	V/µs
Circuit-commutated turn-off time at $T_j = 125\ ^{o}C$ BTW30-300R to 600R:	t_q	<	6	µs
BTW30-800R to 1200R:	t_q	<	12	µs

MECHANICAL DATA see page 2

MECHANICAL DATA Dimensions in mm

Similar to TO-48



Net weight: 15 g

Diameter of clearance hole: max. 6.5 mm

Torque on nut: min. 17 kg cm (1.7 Newton-metres)
max. 35 kg cm (3.5 Newton-metres)

Accessories supplied on request: 56264A

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

ANODE TO CATHODE

Voltages [1]

		BTW30-300R	400R	500R	600R	800R	1000R	1200R	
Non-repetitive peak voltages ($t \leq 10$ ms) V_{DSM} [2] = V_{RSM}	max.	300	400	500	600	800	1000	1200	V
Repetitive peak voltages ($\delta \leq 0.01$) $V_{DRM} = V_{RRM}$	max.	300	400	500	600	800	1000	1200	V
Crest working off-state voltage V_{DWM}	max.	300	400	500	600	600	700	800	V
Continuous off-state voltage V_D	max.	300	400	500	600	600	700	800	V

---

[1] To ensure thermal stability: $R_{th\ j-a} \leq 3$ °C/W (d.c. blocking) or ≤ 6 °C/W (square wave; $\delta = 0.5$)
For smaller heatsinks $T_{j\ max}$ should be derated. For square wave see page 6.
For d.c. blocking: if $R_{th\ j-a} = 5$ °C/W, then $T_{j\ max} = 117$ °C,
if $R_{th\ j-a} = 10$ °C/W, then $T_{j\ max} = 100$ °C.

[2] Higher off-state voltages may be applied without damage, but at voltages higher than the minimum forward breakover voltage ($V_{(BO)}$) the thyristor may switch into the on-state. The rate of rise of on-state current should not exceed 30 A/μs.

RATINGS (continued)

Currents

Average on-state current assuming zero switching losses (averaged over any 20 ms period)				
square wave; δ = 0.5 up to T_{mb} = 65 °C	$I_{T(AV)}$	max.	16	A
at T_{mb} = 85 °C	$I_{T(AV)}$	max.	12	A
sinusoidal at T_{mb} = 85 °C	$I_{T(AV)}$	max.	10	A
On-state current (d.c.)	I_T	max.	25	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	25	A
Repetitive peak on-state current	I_{TRM}	max.	150	A
Non-repetitive peak on-state current				
half sine wave; t = 10 ms; T_j = 125 °C prior to surge	I_{TSM}	max.	150	A
square pulse ; t = 5 ms; T_j = 125 °C prior to surge	I_{TSM}	max.	150	A
Rate of rise of on-state current after triggering with I_G = 1 A to I_T = 50 A; dI_G/dt = 1A/µs	$\frac{dI_T}{dt}$	max.	100	A/µs
Rate of rise of on-state current after triggering	dI_T/dt	max.	30	A/µs

GATE TO CATHODE

Voltages

Reverse peak voltage	V_{RGM}	max.	10	V

Power dissipation

Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	1.0	W
Peak power dissipation	P_{GM}	max.	5.0	W

TEMPERATURES

Storage temperature	T_{stg}	−55 to +125		°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j-mb}$	=	1.0	°C/W
From mounting base to heatsink with heatsink compound	$R_{th\ mb-h}$	=	0.2	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j-mb}$	=	0.06	°C/W

CHARACTERISTICS

ANODE TO CATHODE

Voltages

On-state voltage
$I_T = 50$ A; $T_j = 25$ °C $V_T < 5.0$ V

			BTW30-300R	400R	500R	600R	800R	1000R	1200R	
Forward breakover voltage up to $T_j = 125$ °C	$V_{(BO)}$	>	400	500	600	700	900	1100	1300	V
Rate of rise of off-state voltage that will not trigger any device; $T_j = 125$ °C	$\frac{dV_D}{dt}$	<	200	200	200	200	200	200	200	V/µs
Currents										
Peak off-state current $V_{DM} = V_{DWMmax}$; $T_j = 125$ °C	I_{DM}	<	13	11	9	7	7	6	5	mA

Latching current; $T_j = 25$ °C $I_L < 200$ mA

Holding current; $T_j = 25$ °C $I_H < 200$ mA

GATE TO CATHODE

Voltages

Voltage that will trigger all devices
$V_D = 6$ V; $T_j = 25$ °C $V_{GT} > 2.5$ V

Voltage that will not trigger any device
$V_D = V_{DRMmax}$; $T_j = 125$ °C $V_{GD} < 0.2$ V

Current

Current that will trigger all devices
$V_D = 6$ V; $T_j = 25$ °C $I_{GT} > 150$ mA

SWITCHING CHARACTERISTICS

Turn-on time ($t_{on} = t_d + t_r$) when switched from

$V_D = 800$ V to $I_T = 50$ A $t_d < 1.0$ µs
$I_{GT} = 150$ mA; $dI_G/dt = 1$ A/µs; $T_j = 25$ °C $t_r < 1.0$ µs

Circuit-commutated turn-off time when switched from

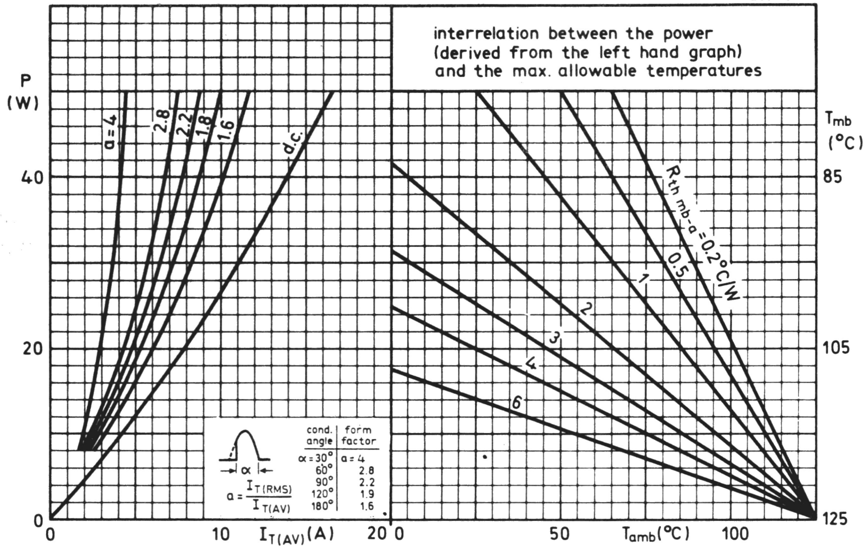
$I_T = 10$ A to $V_R \geq 50$ V

with $-dI_T/dt = 10$ A/µs; $\frac{dV_D}{dt} = 50$ V/µs; $T_j = 125$ °C
BTW30-300R to 600R: $t_q < 6$ µs
BTW30-800R to 1200R: $t_q < 12$ µs

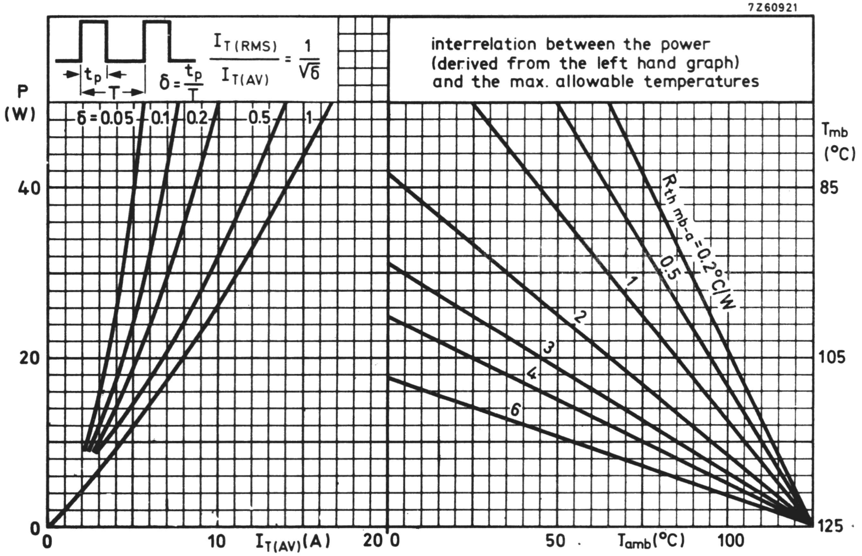
OPERATING NOTES

The gate and cathode connectors should not be bent; they should be soldered into the circuit so that there is no strain on them.
During soldering the heat conduction to the junction should be kept to a minimum.

7Z60919



7Z60921



FAST TURN-OFF THYRISTORS

The BTW31 series is a range of medium current fast turn-off thyristors in a metal envelope similar to TO-48 with M6 thread. They are intended for use in inverter applications up to frequencies of 25 kHz.

The BTW31 series consists of reverse polarity types (anode to stud) BTW31-300R to 1200 R.

QUICK REFERENCE DATA

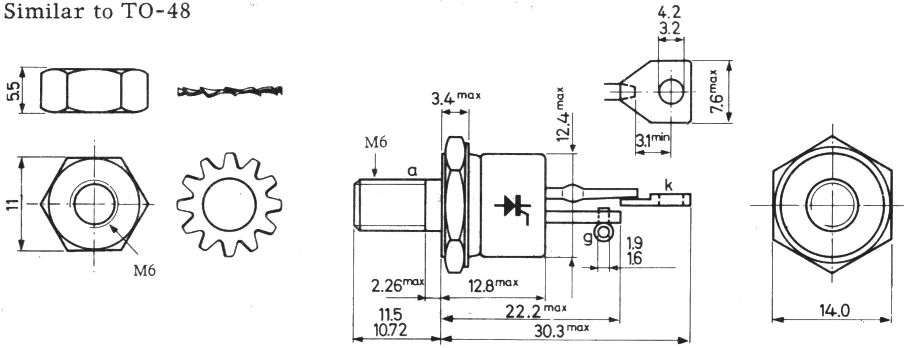
		BTW31-300 R	400 R	500 R	600 R	800 R	1000 R	1200 R	
Repetitive peak voltages $V_{DRM} = V_{RRM}$	max.	300	400	500	600	800	1000	1200	V
Crest working off-state voltage V_{DWM}	max.	300	400	500	600	600	700	800	V
Forward breakover voltage $V_{(BO)}$	>	400	500	600	700	900	1100	1300	V

Average on-state current (square wave; $\delta = 0.5$) up to $T_{mb} = 65\ ^{o}C$	$I_{T(AV)}$	max.	22	A
at $T_{mb} = 85\ ^{o}C$	$I_{T(AV)}$	max.	16	A
R. M. S. on-state current	$I_{T(RMS)}$	max.	31	A
Non-repetitive peak on-state current single square pulse; t = 5 ms $T_j = 125\ ^{o}C$ prior to surge	I_{TSM}	max.	225	A
Junction temperature	T_j	max.	125	^{o}C
Rate of rise of on-state current after triggering	$\frac{dI_T}{dt}$	max.	100	A/µs
Rate of rise of off-state voltage that will not trigger any device	$\frac{dV_D}{dt}$	<	200	V/µs
Circuit-commutated turn-off time at $T_j = 125\ ^{o}C$ BTW31-300 R to 600 R:	t_q	<	12	µs
BTW31-800 R to 1200 R:	t_q	<	20	µs

MECHANICAL DATA see page 2

MECHANICAL DATA Dimensions in mm

Similar to TO-48



Net weight: 15 g

Diameter of clearance hole: max. 6.5 mm

Torque on nut: min. 17 kg cm (1.7 Newton-metres)
max. 35 kg cm (3.5 Newton-metres)

Accessories supplied on request: 56264A

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

ANODE TO CATHODE

Voltages 1)

		BTW31-300R	400R	500R	600R	800R	1000R	1200R	
Non-repetitive peak voltages ($t \leq 10$ ms) V_{DSM} 2) = V_{RSM}	max.	300	400	500	600	800	1000	1200	V
Repetitive peak voltages ($\delta \leq 0.01$) $V_{DRM} = V_{RRM}$	max.	300	400	500	600	800	1000	1200	V
Crest working off-state voltage V_{DWM}	max.	300	400	500	600	700	700	800	V
Continuous off-state voltage V_D	max.	300	400	500	600	700	700	800	V

---

1) To ensure thermal stability: $R_{th\ j\text{-}a} \leq 3$ °C/W (d.c. blocking) or ≤ 6 °C/W (square wave; $\delta = 0.5$)
For smaller heatsinks $T_{j\ max}$ should be derated. For square wave see page 6.
For d.c. blocking: if $R_{th\ j\text{-}a} = 5$ °C/W, then $T_{j\ max} = 117$ °C,
if $R_{th\ j\text{-}a} = 10$ °C/W; then $T_{j\ max} = 100$ °C.

2) Higher off-state voltages may be applied without damage, but at voltages higher than the minimum forward breakover voltage ($V_{(BO)}$) the thyristor may switch into the on-state. The rate of rise of on-state current should not exceed 30 A/µs.

RATINGS (continued)

Currents

Average on-state current assuming zero switching losses (averaged over any 20 ms period)				
square wave; δ = 0.5 up to T_{mb} = 65 °C	$I_{T(AV)}$	max.	22	A
at T_{mb} = 85 °C	$I_{T(AV)}$	max.	16	A
sinusoidal at T_{mb} = 85 °C	$I_{T(AV)}$	max.	15	A
On-state current (d.c.) at T_{mb} = 50 °C	I_T	max.	31	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	31	A
Repetitive peak on-state current	I_{TRM}	max.	150	A
Non-repetitive peak on-state current				
half sine wave; t = 10 ms; T_j = 125 °C prior to surge	I_{TSM}	max.	225	A
square pulse; t = 5 ms; T_j = 125 °C prior to surge	I_{TSM}	max.	225	A
Rate of rise of on-state current after triggering with I_G = 1 A to I_T = 50 A; dI_G/dt = 1 A/µs	$\frac{dI_T}{dt}$	max.	100	A/µs
Rate of rise of on-state current after triggering	dI_T/dt	max.	30	A/µs

GATE TO CATHODE

Voltages

Reverse peak voltage	V_{RGM}	max.	10	V

Power dissipation

Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	1.0	W
Peak power dissipation	P_{GM}	max.	5.0	W

TEMPERATURES

Storage temperature	T_{stg}	−55 to +125		°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.0	°C/W
From mounting base to heatsink with heatsink compound	$R_{th\ mb\text{-}h}$	=	0.2	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.06	°C/W

CHARACTERISTICS

ANODE TO CATHODE

Voltages

On-state voltage I_T = 50 A; T_j = 25 °C	V_T	$<$	2.9	V

			BTW31-300R	400R	500R	600R	800R	1000R	1200R	
Forward breakover voltage up to T_j = 125 °C	$V_{(BO)}$	$>$	400	500	600	700	900	1100	1300	V
Rate of rise of off-state voltage that will not trigger any device; T_j = 125 °C	$\frac{dV_D}{dt}$	$<$	200	200	200	200	200	200	200	V/μs

Currents

			BTW31-300R	400R	500R	600R	800R	1000R	1200R	
Peak off-state current $V_{DM} = V_{DWMmax}$; T_j = 125 °C	I_{DM}	$<$	13	11	9	7	7	6	5	mA

Latching current; T_j = 25 °C	I_L	$<$	200	mA
Holding current; T_j = 25 °C	I_H	$<$	200	mA

GATE TO CATHODE

Voltages

Voltage that will trigger all devices V_D = 6 V; T_j = 25 °C	V_{GT}	$>$	2.5	V
Voltage that will not trigger any device $V_D = V_{DRMmax}$; T_j = 125 °C	V_{GD}	$<$	0.2	V

Current

Current that will trigger all devices V_D = 6 V; T_j = 25 °C	I_{GT}	$>$	150	mA

SWITCHING CHARACTERISTICS

Turn-on time ($t_{on} = t_d + t_r$) when switched from

V_D = 600 V to I_T = 50 A	t_d	$<$	1.0	μs
I_{GT} = 150 mA; dI_G/dt = 1 A/μs; T_j = 25 °C	t_r	$<$	1.0	μs

Circuit-commutated turn-off time when switched from

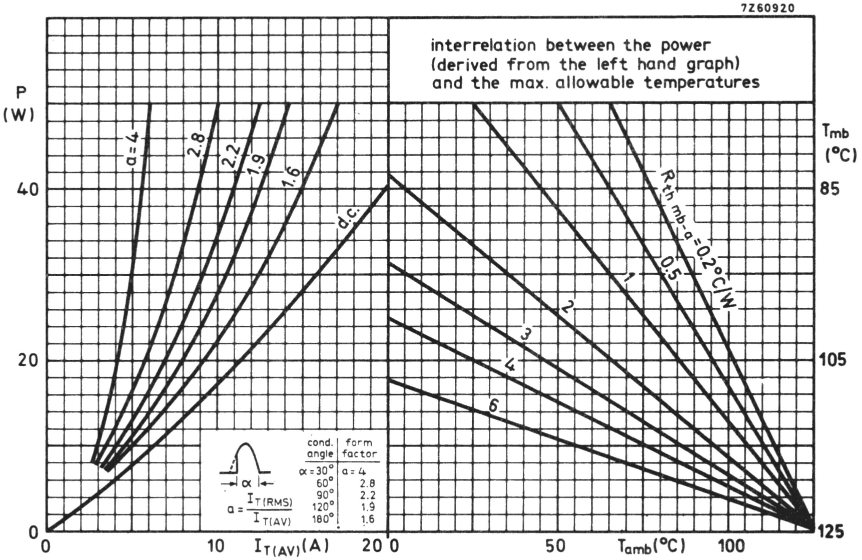
I_T = 10 A to $V_R \geq 50$ V

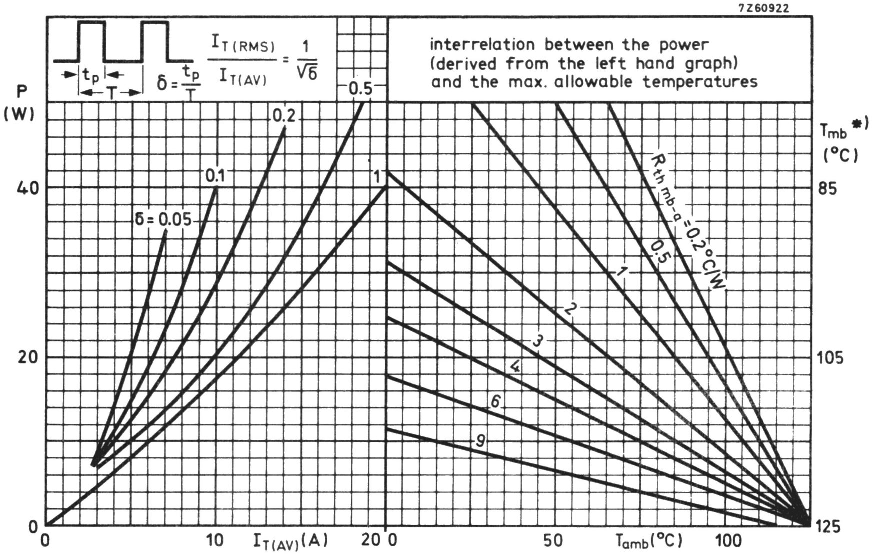
with $-dI_T/dt$ = 10 A/μs; $\frac{dV_D}{dt}$ = 50 V/μs; T_j = 125 °C

BTW31-300R to 600R:	t_q	$<$	12	μs
BTW31-800R to 1200R:	t_q	$<$	20	μs

OPERATING NOTES

The gate and cathode connectors should not be bent; they should be soldered into the circuit so that there is no strain on them.
During soldering the heat conduction to the junction should be kept to a minimum.





*) T_{mb} -scale is for comparison purposes only and is correct only for $R_{th\,mb-a} \leq 6$ °C/W

14A AVALANCHE THYRISTORS

Silicon thyristors in metal envelopes, with avalanche properties. A version with guaranteed values of avalanche voltage and avalanche power can be supplied on request. BTW47series-M has metric thread, BTW47series-U UNF thread. Both series consist of reverse polarity types (anode to stud) identified by a suffix R: BTW47-600RM to 1600RM and BTW47-600RU to 1600RU.

QUICK REFERENCE DATA

		BTW47-600RM BTW47-600RU	800RM 800RU	1000RM 1000RU	1200RM 1200RU	1400RM 1400RU	1600RM 1600RU	
Repetitive peak voltages $V_{DRM} = V_{RRM}$	max.	600	800	1000	1200	1400	1600	V
Crest working voltages $V_{DWM} = V_{RWM}$	max.	600	800	1000	1200	1200	1200	V
Forward breakover voltage $V_{(BO)}$	>	700	900	1100	1300	1400	1600	V

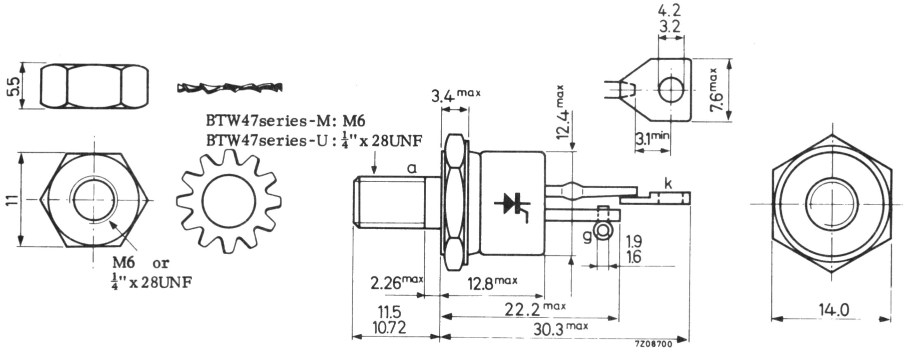
Average on-state current at T_{mb} = 85 °C	$I_{T(AV)}$	max.	14	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	25	A
Non-repetitive peak on-state current t = 10 ms; T_j = 125 °C prior to surge	I_{TSM}	max.	220	A
Junction temperature	T_j	max.	125	°C
Rate of rise of on-state current after triggering	$\frac{dI_T}{dt}$	max.	200	A/µs
Rate of rise of off-state voltage that will not trigger any device	$\frac{dV_D}{dt}$		300	V/µs

MECHANICAL DATA see page 2

MECHANICAL DATA

Dimensions in mm

Similar to TO-48


5.5
11
BTW47series-M: M6
BTW47series-U: ¼" x 28UNF
M6 or
¼" x 28UNF
3.4 max
12.4 max
4.2
3.2
7.6 max
3.1 min
a
k
g
1.9
1.6
2.26 max
12.8 max
11.5
10.72
22.2 max
30.3 max
14.0
7Z08700

Net weight: 15 g
Diameter of clearance hole: max. 6.5 mm
Accessories supplied on request: 56264 A

Torque on nut: min. 17 kg cm
(1.7 Newton-metres)
max. 35 kg cm
(3.5 Newton-metres)

All information applies to frequencies up to 400 Hz.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

ANODE TO CATHODE Voltages [1]		BTW47-600RM BTW47-600RU	800RM 800RU	1000RM 1000RU	1200RM 1200RU	1400RM 1400RU	1600RM 1600RU	
Non-repetitive peak voltages ($t \leq 10$ ms) V_{DSM} [2] $= V_{RSM}$	max.	700	900	1100	1300	1400	1600	V
Repetitive peak voltages ($\delta \leq 0.01$) $V_{DRM} = V_{RRM}$	max.	600	800	1000	1200	1400	1600	V
Crest working voltages $V_{DWM} = V_{RWM}$	max.	600	800	1000	1200	1200	1200	V
Continuous voltages $V_D = V_R$	max.	600	800	1000	1200	1200	1200	V

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[1] To ensure thermal stability: $R_{th\ j\text{-}a} < 1.5\,^{\circ}C/W$ (d.c. blocking) or $< 3\,^{\circ}C/W$ (a.c.) For smaller heatsinks $T_{j\ max}$ should be derated. For a.c. see page 6.

[2] Higher off-state voltages may be applied without damage, but at voltages higher than the minimum forward breakover voltage ($V_{(BO)}$) the thyristor may switch into the on-state. The rate of rise of on-state current should not exceed 100 A/µs.

RATINGS (continued)

Currents

Average on-state current (averaged over any 20 ms period) at T_{mb} = 85 °C	$I_{T(AV)}$	max.	14	A
On-state current (d.c.)	I_T	max.	25	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	25	A
Repetitive peak on-state current	I_{TRM}	max.	150	A
Non-repetitive peak on-state current (t = 10 ms; half sine wave) T_j = 125°C prior to surge	I_{TSM}	max.	220	A
I^2t for fusing (t = 10 ms)	I^2t	max.	240	A^2s
Rate of rise of on-state current after triggering with $I_G = I_{GT}$ to $I_T = 3 \times I_{T(AV)}$	$\frac{dI_T}{dt}$	max.	200	A/µs
Rate of rise of on-state current after breakover	$\frac{dI_T}{dt}$	max.	100	A/µs
Rate of change of cummutation current	see nomogram on page 10			

GATE TO CATHODE

Voltage

Reverse peak voltage	V_{RGM}	max.	10	V

Power dissipation

Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	1	W
Peak power dissipation	P_{GM}	max.	5	W

TEMPERATURES

Storage temperature	T_{stg}		−55 to +125	°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j-mb}$	=	1	°C/W
From mounting base to heatsink	$R_{th\ mb-h}$	=	0.2	°C/W
Transient thermal impedance (t = 1 ms)	$Z_{th\ j-mb}$	=	0.06	°C/W

CHARACTERISTICS

ANODE TO CATHODE			BTW47-600RM BTW47-600RU	800RM 800RU	1000RM 1000RU	1200RM 1200RU	1400RM 1400RU	1600RM 1600RU	
Voltages									
On-state voltage I_T = 50 A; T_j = 25 °C	V_T	<	3	3	3	3	3	3	V
Forward breakover voltage up to T_j = 125 °C	$V_{(BO)}$	>	700	900	1100	1300	1400	1600	V
Rate of rise of off-state voltage that will not trigger any device; T_j = 125 °C	$\frac{dV_D}{dt}$	<	300	300	300	300	300	300	V/μs
Currents									
Peak reverse current $V_{RM}=V_{RWMmax}$; T_j = 125°C	I_{RM}	<	13	10	8	7	7	7	mA
Peak off-state current $V_{DM}=V_{DWMmax}$; T_j = 125°C	I_{DM}	<	13	10	8	7	7	7	mA

Latching current; T_j = 25 °C	I_L	<	200	mA
Holding current; T_j = 25 °C	I_H	<	200	mA

GATE TO CATHODE

Voltages				
Voltage that will trigger all devices V_D = 6 V; T_j = 25 °C	V_{GT}	>	3.5	V
Voltage that will not trigger any device $V_D = V_{DWMmax}$; T_j = 125 °C	V_{GD}	<	200	mV
Current				
Current that will trigger all devices V_D = 6 V; T_j = 25 °C	I_{GT}	>	150	mA

CHARACTERISTICS (continued)

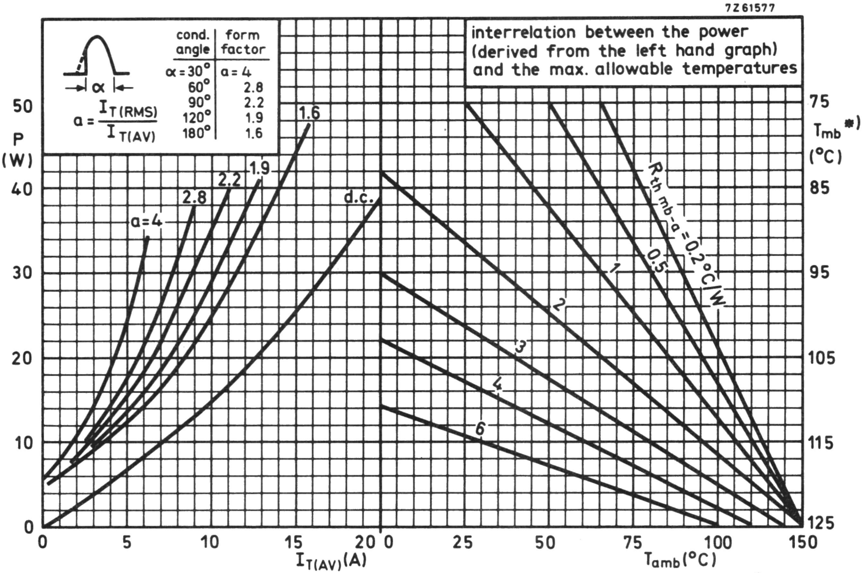
SWITCHING CHARACTERISITICS

Turn-on time ($t_{on} = t_d + t_r$) when switched from $V_D = V_{DWMmax}$ to $I_T = 10$ A $I_{GT} = 150$ mA; $dI_G/dt = 1$ A/µs; $T_j = 25\ ^oC$	t_{on} t_r	typ. typ.	2 1.2	µs µs
Circuit-commutated turn-off time when switched from $I_T = 10$ A to $V_R \geq 50$ V with $-dI_T/dt = 10$ A/µs; $dV_D/dt = 10$ V/µs				
$T_j = 125\ ^oC$	t_q t_q	typ. <	75 250	µs µs
$T_j = 25\ ^oC$	t_q t_q	typ. <	40 100	µs µs

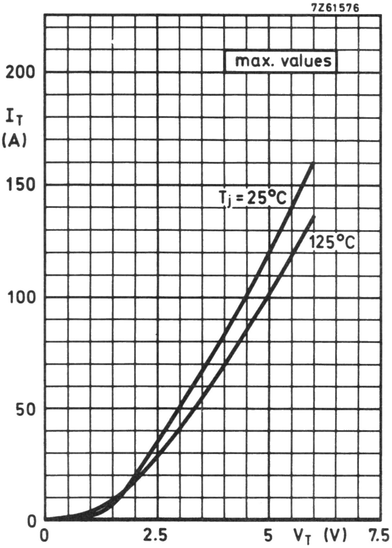
OPERATING NOTES

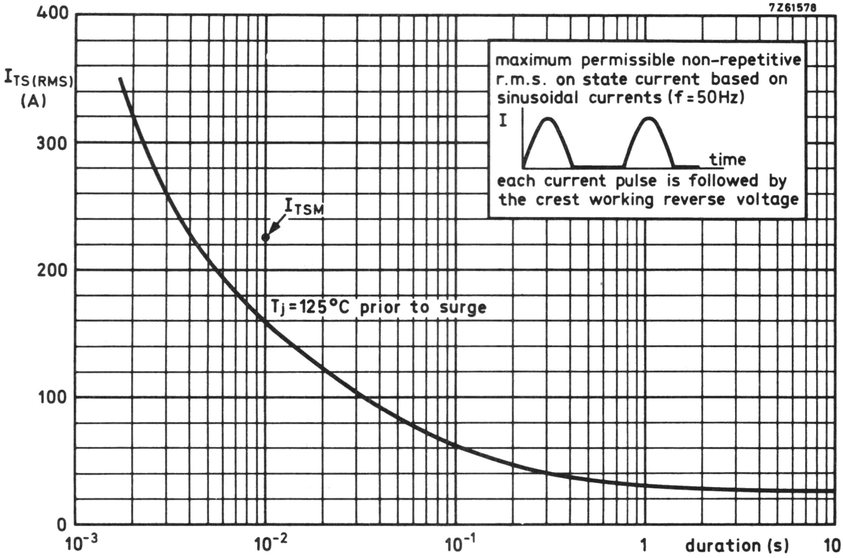
1. The gate and cathode connectors should not be bent; they should be soldered into the circuit so that there is no strain on them.
2. Switching losses in commutation

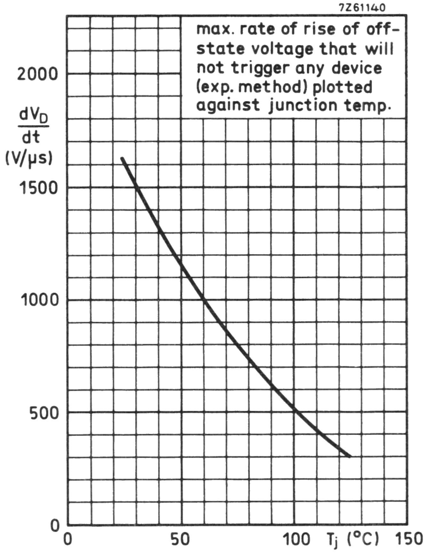
   For applications in which the thyristor is forced to switch from an on-state current I_{TRM} to a high reverse voltage at a high commutation rate ($-dI/dt$), consult the nomogram on page 10 to find the increase in total average power.
   This increase must be added to the losses derived from the curves on page 6.

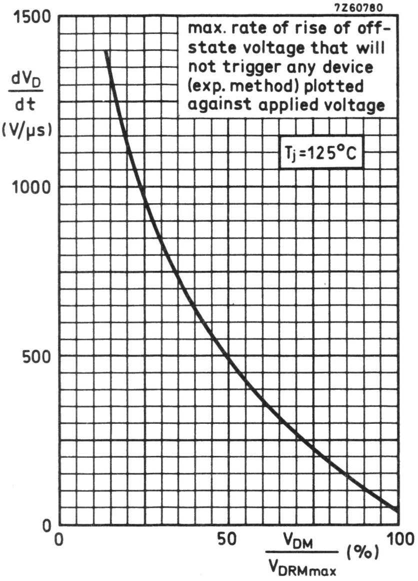


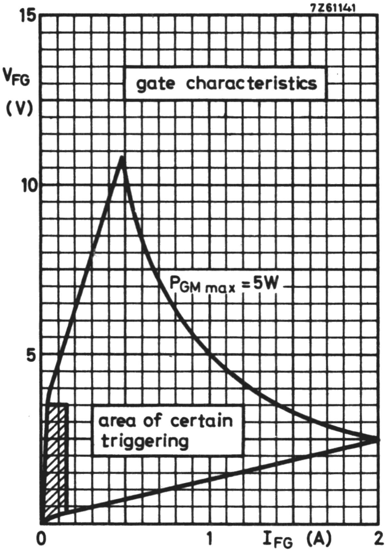
*) T_{mb} – scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leq 2$ °C/W

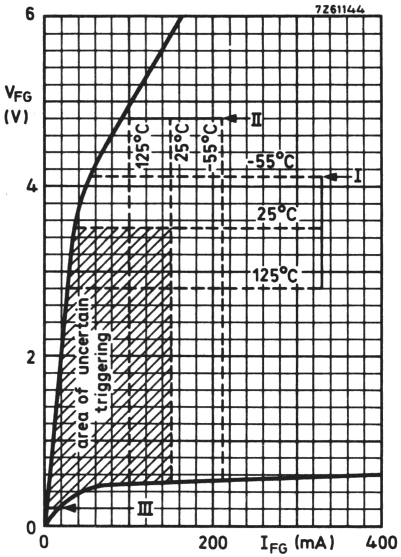



7Z61578
400
300
200
100
0
$I_{TS(RMS)}$
(A)
maximum permissible non-repetitive r.m.s. on state current based on sinusoidal currents (f = 50Hz)
I
time
each current pulse is followed by the crest working reverse voltage
I_{TSM}
T_j = 125 °C prior to surge
10^{-3}
10^{-2}
10^{-1}
1
duration (s)
10


7Z61140
max. rate of rise of off-state voltage that will not trigger any device (exp. method) plotted against junction temp.
2000
1500
1000
500
0
$\frac{dV_D}{dt}$
(V/μs)
0
50
100
T_j (°C)
150


7Z60780
max. rate of rise of off-state voltage that will not trigger any device (exp. method) plotted against applied voltage
T_j = 125 °C
1500
1000
500
0
$\frac{dV_D}{dt}$
(V/μs)
0
50
100
$\frac{V_{DM}}{V_{DRMmax}}$ (%)

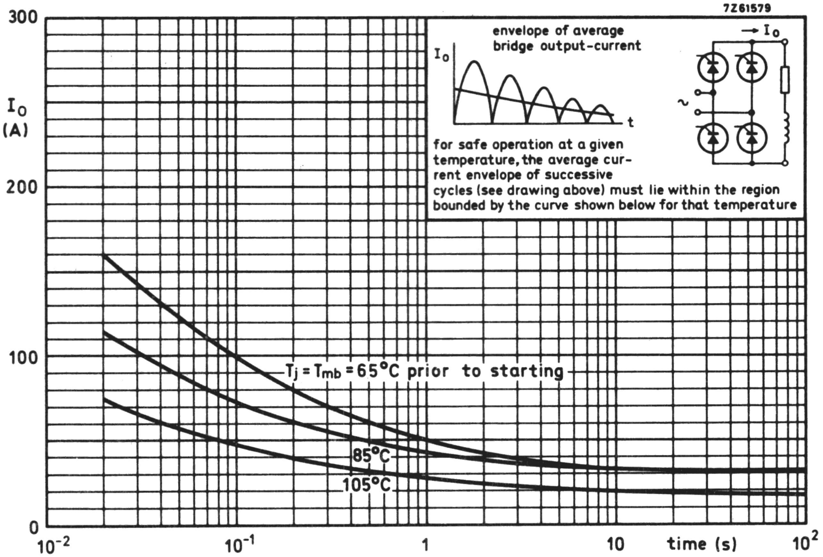


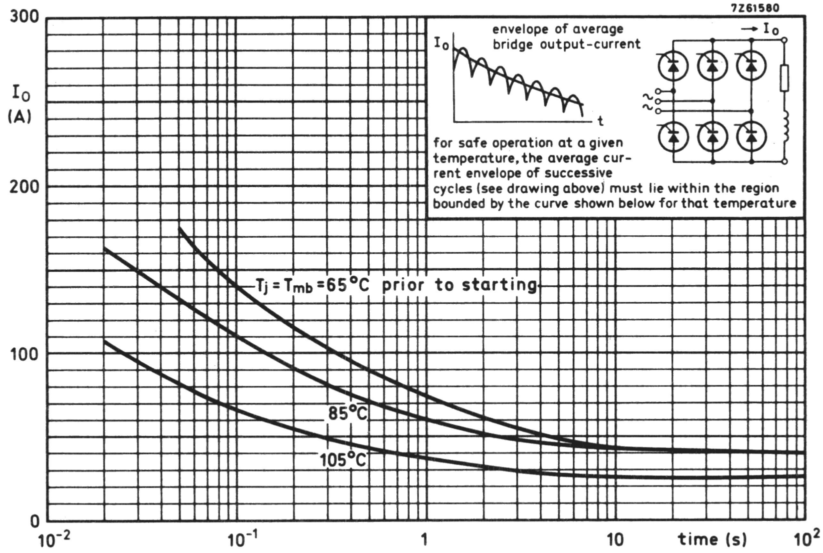


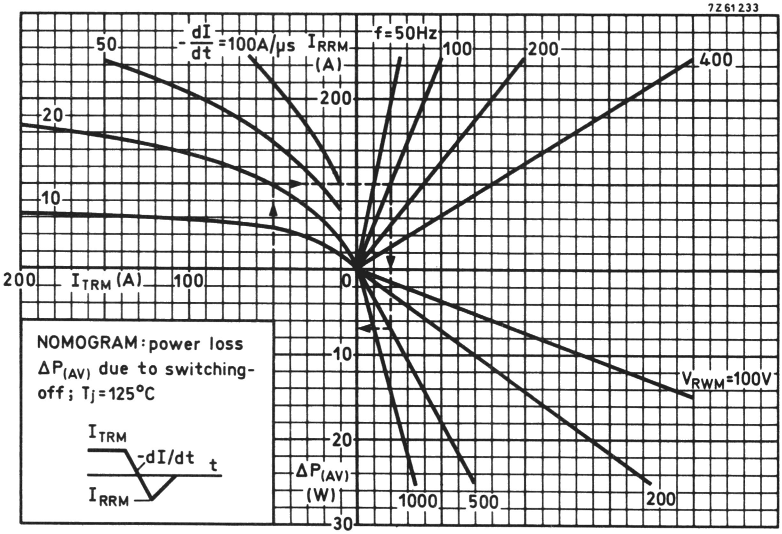
I = minimum gate voltage that will trigger all devices at T_j = →

II = minimum gate current that will trigger all devices at T_j = →

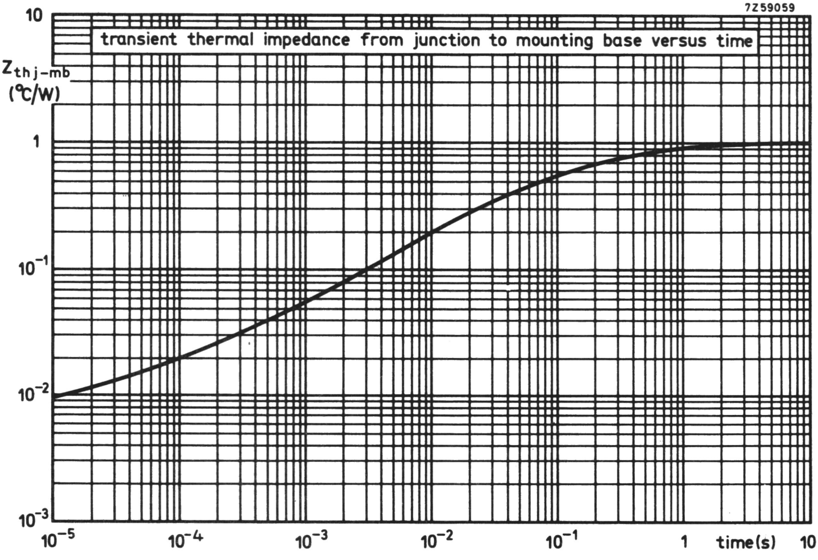
III = maximum gate voltage that will not trigger any device at T_j = →


7Z61579
envelope of average bridge output-current
I_o
t
$\rightarrow I_o$
~
for safe operation at a given temperature, the average current envelope of successive cycles (see drawing above) must lie within the region bounded by the curve shown below for that temperature
I_O (A)
300
200
100
0
$T_j = T_{mb} = 65°C$ prior to starting
85°C
105°C
10^{-2}
10^{-1}
1
10
time (s)
10^2


7Z61580
envelope of average bridge output-current
I_o
t
$\rightarrow I_o$
~
~
~
for safe operation at a given temperature, the average current envelope of successive cycles (see drawing above) must lie within the region bounded by the curve shown below for that temperature
I_O (A)
300
200
100
0
$T_j = T_{mb} = 65°C$ prior to starting
85°C
105°C
10^{-2}
10^{-1}
1
10
time (s)
10^2



NOMOGRAM: power loss $\Delta P_{(AV)}$ due to switching-off; $T_j = 125°C$



transient thermal impedance from junction to mounting base versus time

20 A AVALANCHE THYRISTORS

Silicon thyristors in metal envelopes, with avalanche properties.
A version with guaranteed values of avalanche voltage and avalanche power can be supplied on request.
BTW92series-M has metric thread, BTW92series-U UNF thread. Both series consist of reverse polarity types (anode to stud) identified by a suffix R:
BTW92-600RM to 1600RM and BTW92-600RU to 1600RU.

QUICK REFERENCE DATA

		BTW92-600RM BTW92-600RU	800RM 800RU	1000RM 1000RU	1200RM 1200RU	1400RM 1400RU	1600RM 1600RU	
Repetitive peak voltages $V_{DRM} = V_{RRM}$	max.	600	800	1000	1200	1400	1600	V
Crest working voltages $V_{DWM} = V_{RWM}$	max.	600	800	1000	1200	1200	1200	V
Forward breakover voltage $V_{(BO)}$	>	700	900	1100	1300	1400	1600	V

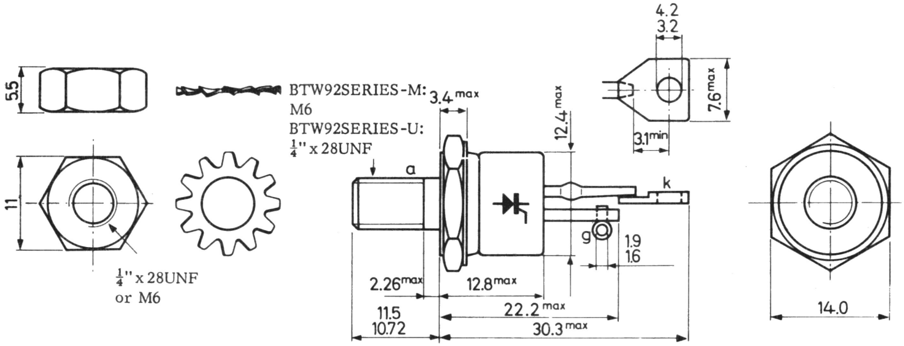
Average on-state current at T_{mb} = 85 °C	$I_{T(AV)}$	max.	20	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	31	A
Non-repetitive peak on-state current t = 10 ms; T_j = 125 °C prior to surge	I_{TSM}	max.	320	A
Junction temperature	T_j	max.	125	°C
Rate of rise of on-state current after triggering	$\frac{dI_T}{dt}$	max.	300	A/µs
Rate of rise of off-state voltage that will not trigger any device	$\frac{dV_D}{dt}$	<	300	V/µs

MECHANICAL DATA see page 2

MECHANICAL DATA

Dimensions in mm

Similar to TO-48


5.5
11
BTW92SERIES-M: M6
BTW92SERIES-U: $\frac{1}{4}$" x 28UNF
3.4 max
12.4 max
4.2
3.2
7.6 max
3.1 min
a
k
g
1.9
1.6
$\frac{1}{4}$" x 28UNF or M6
2.26 max
12.8 max
11.5
10.72
22.2 max
30.3 max
14.0

Torque on nut: min. 17 kg cm
(1.7 Newton-metres)
max. 35 kg cm
(3.5 Newton-meters)

Net weight: 15 g
Diameter of clearance hole: max. 6.5 mm
Accessories supplied on request: 56264A

All information applies to frequencies up to 400 Hz.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

ANODE TO CATHODE		BTW92-600RM BTW92-600RU	800RM 800RU	1000RM 1000RU	1200RM 1200RU	1400RM 1400RU	1600RM 1600RU
Voltages (1)							
Non-repetitive peak voltages ($t \leq 10$ ms) V_{DSM} (2) = V_{RSM}	max.	700	900	1100	1300	1400	1600 V
Repetitive peak voltages $V_{DRM} = V_{RRM}$	max.	600	800	1000	1200	1400	1600 V
Crest working voltages $V_{DWM} = V_{RWM}$	max.	600	800	1000	1200	1200	1200 V
Continuous voltages $V_D = V_R$	max.	600	800	1000	1200	1400	1600 V

---

(1) To ensure thermal stability: $R_{th\ j-a} < 1.5\ ^{o}C/W$ (d.c. blocking) or $< 3\ ^{o}C/W$ (a.c.). For smaller heatsinks $T_{j\ max}$ should be derated. For a.c. see page 6.

(2) Higher off-state voltages may be applied without damage, but at voltages higher than the minimum forward breakover voltage (see page 4) the thyristor may switch into the on-state. The rate of rise of on-state current should not exceed 100 A/μs.

RATINGS (continued)

Currents

Average on-state current (averaged over any 20 ms period) at T_{mb} = 85 °C	$I_{T(AV)}$	max.	20	A
On-state current (d.c.)	I_T	max.	31	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	31	A
Repetitive peak on-state current	I_{TRM}	max.	200	A
Non-repetitive peak on-state current (t = 10 ms; half sine wave) T_j = 125 °C prior to surge	I_{TSM}	max.	320	A
I^2t for fusing (t = 10 ms)	I^2t	max.	500	A^2s
Rate of rise of on-state current after triggering with $I_G = I_{GT}$ to $I_T = 3 \times I_{T(AV)}$ (see graph on page 7)	$\frac{dI_T}{dt}$	max.	300	A/µs
Rate of rise of on-state current after breakover (see graph on page 7)	$\frac{dI_T}{dt}$	max.	100	A/µs
Rate of change of commutation current	see nomogram on page 10			

GATE TO CATHODE

Voltage

Reverse peak voltage	V_{RGM}	max.	10	V

Power dissipation

Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	1	W
Peak power dissipation	P_{GM}	max.	5	W

Temperatures

Storage temperature	T_{stg}	−55 to +125		°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.2	°C/W
Transient thermal impedance (t = 1 ms)	$Z_{th\ j\text{-}mb}$	=	0.06	°C/W

CHARACTERISTICS

ANODE TO CATHODE			BTW92-600RM BTW92-600RU	800RM 800RU	1000RM 1000RU	1200RM 1200RU	1400RM 1400RU	1600RM 1600RU	
Voltages									
On-state voltage I_T = 50 A; T_j = 25 °C	V_T	<	2.3	2.3	2.3	2.3	2.3	2.3	V
Forward breakover voltage up to T_j = 125 °C	$V_{(BO)}$	>	700	900	1100	1300	1400	1600	V
Rate of rise of off-state voltage that will not trigger any device; T_j = 125 °C	$\frac{dV_D}{dt}$	<	300	300	300	300	300	300	V/µs
Currents									
Peak reverse current $V_{RM}=V_{RWMmax}$; T_j=125 °C	I_{RM}	<	13	10	8	7	7	7	mA
Peak off-state current $V_{DM}=V_{DWMmax}$; T_j=125 °C	I_{DM}	<	13	10	8	7	7	7	mA

Latching current; T_j = 25 °C	I_L	<	200	mA
Holding current; T_j = 25 °C	I_H	<	200	mA

GATE TO CATHODE

Voltages

Voltage that will trigger all devices V_D = 6 V; T_j = 25 °C	V_{GT}	>	3.5	V
Voltage that will not trigger any device $V_D = V_{DWMmax}$; T_j = 125 °C	V_{GD}	<	200	mV

Current

Current that will trigger all devices V_D = 6 V; T_j = 25 °C	I_{GT}	>	150	mA

CHARACTERISTICS (continued)

SWITCHING CHARACTERISTICS

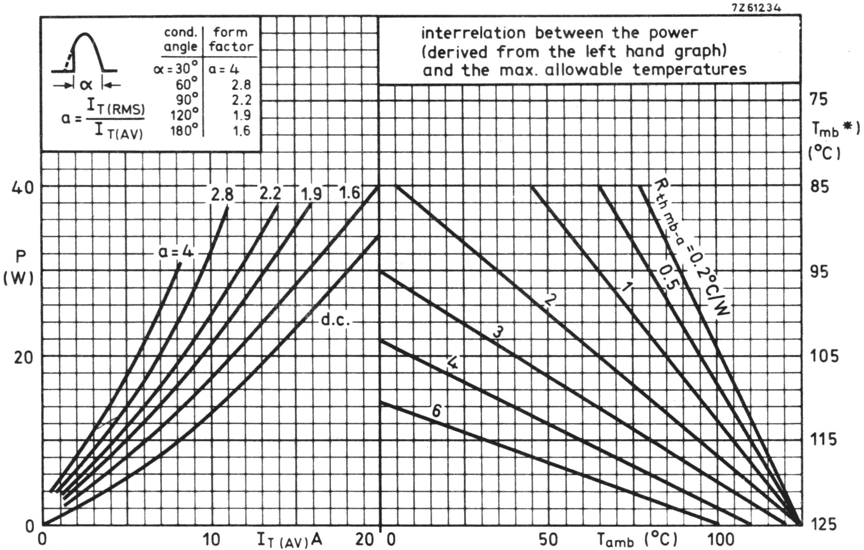
Turn-on time ($t_{on} = t_d + t_r$) when switched from $V_D = V_{DWMmax}$ to $I_T = 10$ A $I_{GT} = 150$ mA; $dI_G/dt = 1$ A/μs; $T_j = 25$ °C	t_{on} t_r	typ. typ.	2 1.2	μs μs
Circuit-commutated turn-off time when switched from $I_T = 10$ A to $V_R \geq 50$ V with $-dI_T/dt = 10$ A/μs; $dV_D/dt = 10$ V/μs $T_j = 125$ °C	t_q	typ. $<$	75 250	μs μs
$T_j = 25$ °C	t_q	typ. $<$	40 100	μs μs

OPERATING NOTES

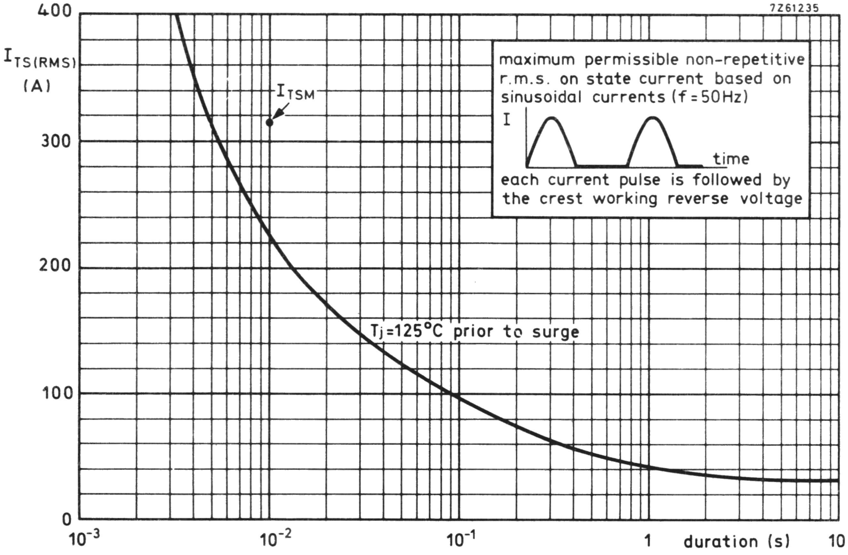
1. The gate and cathode connectors should not be bent; they should be soldered into the circuit so that there is no strain on them.

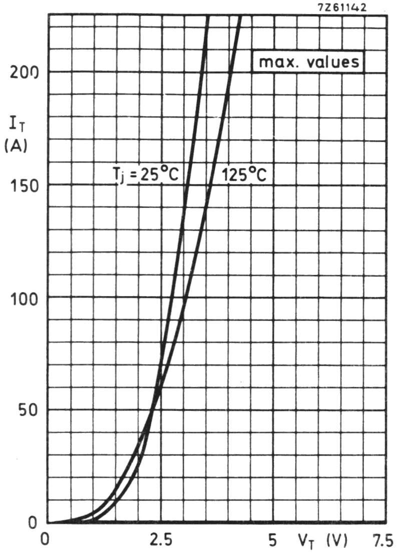
2. Switching losses in commutation

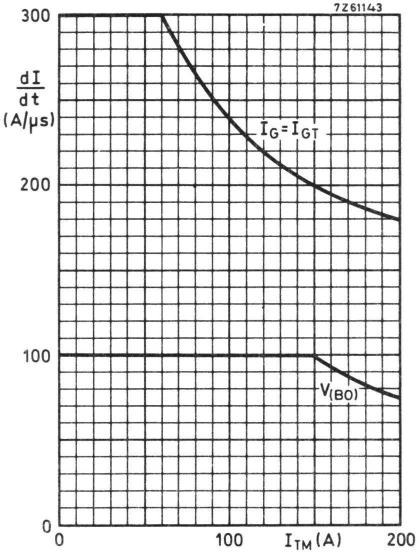
   For applications in which the thyristor is forced to switch from an on-state current I_{TRM} to a high reverse voltage at a high commutation rate (-dI/dt), consult the nomogram on page 10 to find the increase in total average power.
   This increase must be added to the losses derived from the curves on page 6.

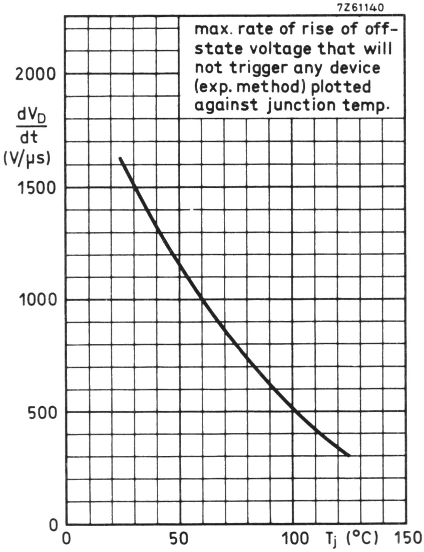


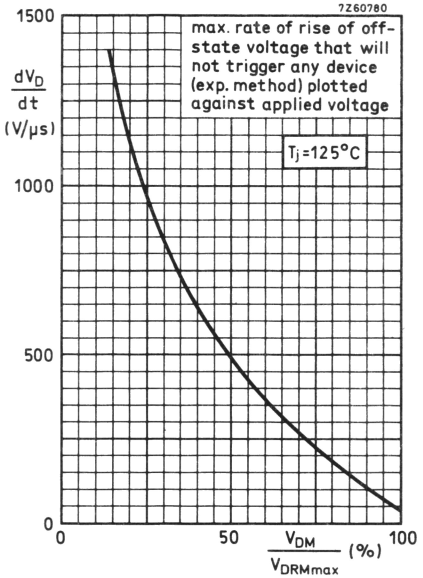
*) T_{mb}-scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leq 2°C/W$

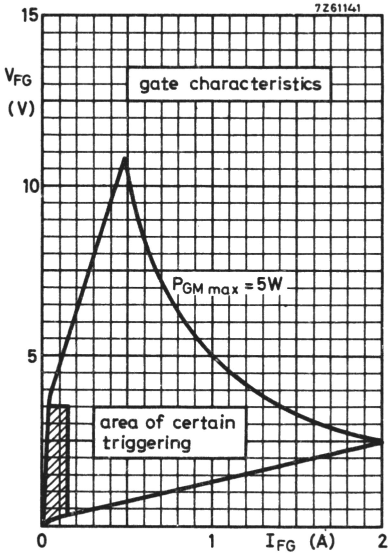


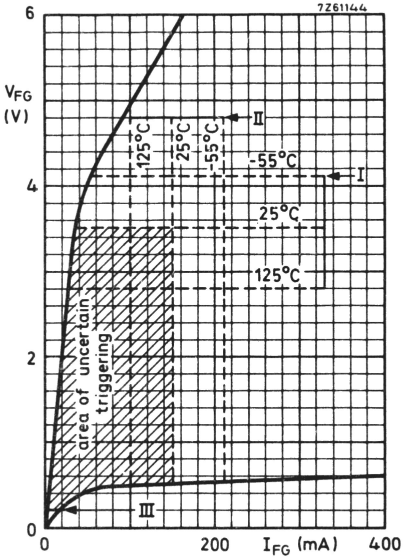

7Z61142
max. values
I_T (A)
0
50
100
150
200
$T_j = 25°C$
125°C
0
2.5
5
V_T (V)
7.5


7Z61143
dI/dt (A/µs)
0
100
200
300
$I_G = I_{GT}$
$V_{(BO)}$
0
100
I_{TM} (A)
200


7Z61140
max. rate of rise of off-state voltage that will not trigger any device (exp. method) plotted against junction temp.
dV_D/dt (V/µs)
0
500
1000
1500
2000
0
50
100
T_j (°C)
150


7Z60780
max. rate of rise of off-state voltage that will not trigger any device (exp. method) plotted against applied voltage
$T_j = 125°C$
dV_D/dt (V/µs)
0
500
1000
1500
0
50
100
V_{DM}/V_{DRMmax} (%)



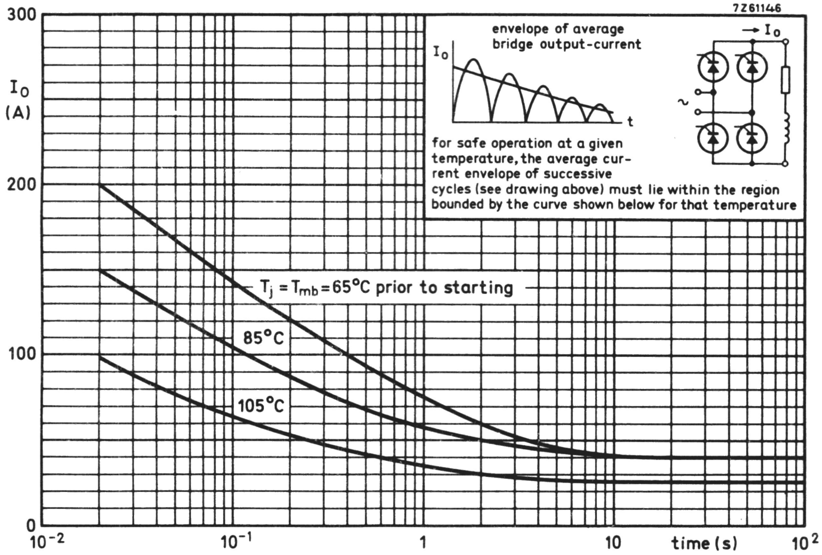


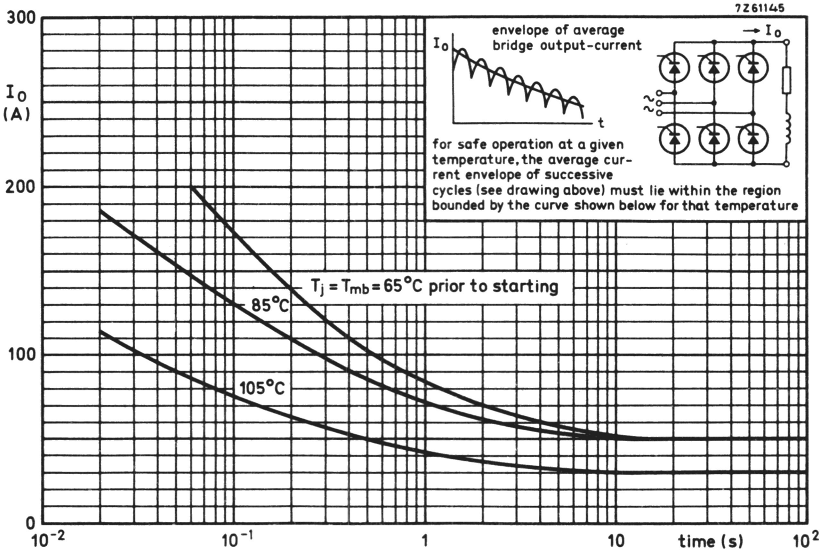
I = minimum gate voltage that will trigger all devices at T_j = →

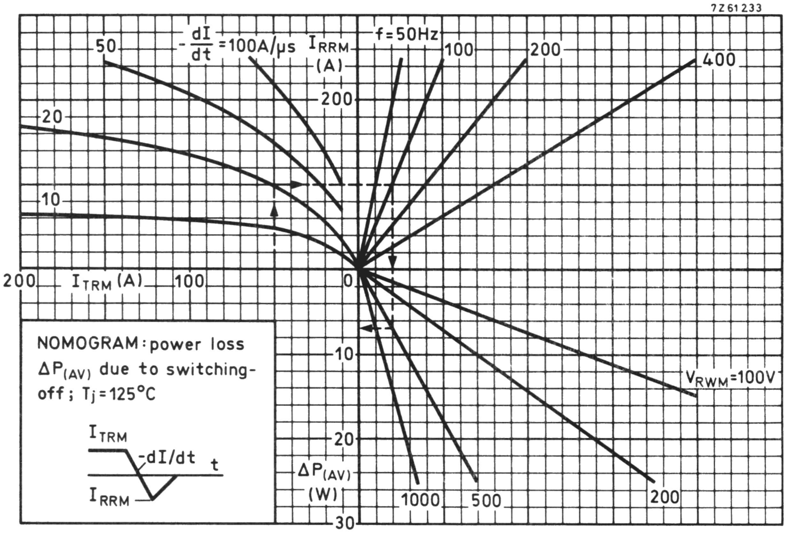
II = minimum gate current that will trigger all devices at T_j = →

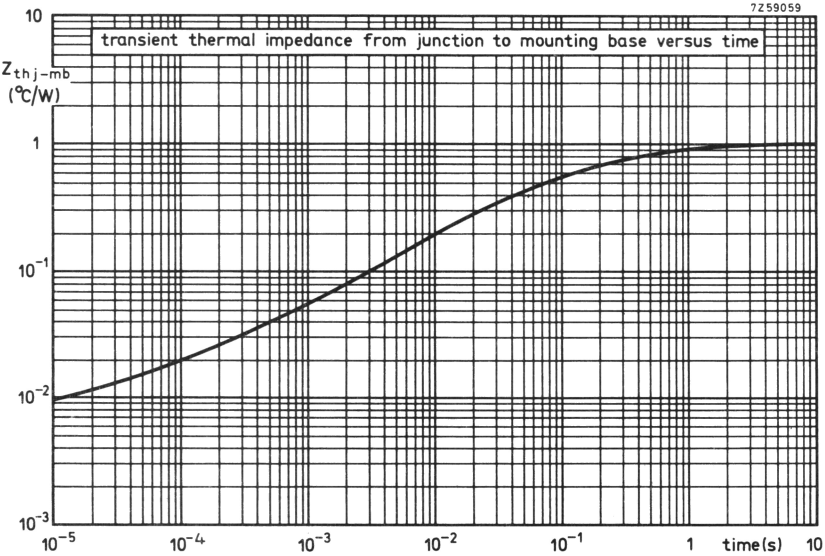
III = maximum gate voltage that will not trigger any device at T_j = →

Limits for starting or inrush-currents






7Z61233
$-\frac{dI}{dt}$ = 100A/μs
50
20
10
I_{RRM} (A)
200
f = 50Hz
100
200
400
200
I_{TRM} (A)
100
0
10
20
30
$\Delta P_{(AV)}$ (W)
V_{RWM} = 100V
200
500
1000
NOMOGRAM: power loss $\Delta P_{(AV)}$ due to switching-off; T_j = 125°C
I_{TRM}
-dI/dt
t
I_{RRM}


7Z59059
transient thermal impedance from junction to mounting base versus time
$Z_{th\,j-mb}$ (°C/W)
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
time(s)
10

SILICON THYRISTORS

The BTX18series is a range of p-gate reverse blocking thyristors, in a TO-5 metal envelope, intended for use in general low power applications up to 1 A average on-state current

QUICK REFERENCE DATA

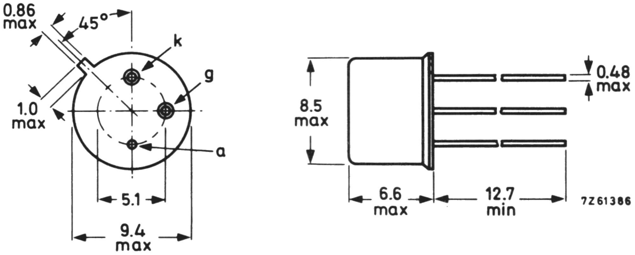
			BTX18-100	200	300	400	500	
Crest working reverse voltage	V_{RWM}	max.	100	200	300	400	500	V
Crest working off-state voltage	V_{DWM}	max.	100	200	300	400	500	V
Average on-state current up to T_{case} = 105 °C	$I_{T(AV)}$	max.			1.0			A
T_{amb} = 60 °C; in free air	$I_{T(AV)}$	max.			250			mA
Non-repetitive peak on-state current t = 10 ms; T_j = 125 °C prior to surge	I_{TSM}	max.			10			A
Junction temperature	T_j	max.			125			°C

MECHANICAL DATA

Dimensions in mm

Anode connected to the case

TO-5



Accessories supplied on request: 56218; 56245; 56265

All information applies to frequencies up to 400 Hz

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

ANODE TO CATHODE

Voltages [1]

			BTX18-100	200	300	400	500	
Continuous reverse voltage	V_R	max.	100	200	300	400	500	V
Crest working reverse voltage	V_{RWM}	max.	100	200	300	400	500	V
Repetitive peak reverse voltage (δ = 0.01; f = 50 Hz)	V_{RRM}	max.	120	240	350	500	600	V
Non-repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	120	240	350	500	600	V
Continuous off-state voltage	V_D	max.	100	200	300	400	500	V
Crest working off-state voltage	V_{DWM}	max.	100	200	300	400	500	V
Repetitive peak off-state voltage (δ = 0.01; f = 50 Hz)	V_{DRM}	max.	120	240	350	500	600	V [2]
Non-repetitive peak off-state voltage ($t \leq 10$ ms)	V_{DSM}	max.	120	240	350	500	600	V [2]

Currents

Average on-state current (averaged over any 20 ms period) up to T_{case} = 105 °C	$I_{T(AV)}$	max.	1.0	A
at T_{amb} = 60 °C	$I_{T(AV)}$	max.	250	mA
On-state current (d.c.) T_{case} = 100 °C	I_T	max.	1.6	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	1.6	A
Repetitive peak on-state current	I_{TRM}	max.	10	A
Non-repetitive peak on-state current (t = 10 ms, half sinewave)	I_{TSM}	max.	10	A

---

[1] These ratings apply for zero or negative bias on the gate with respect to the cathode, and when a resistor $R \leq 1$ kΩ is connected between gate and cathode.

[2] The device is not suitable for operation in the forward breakover mode.

RATINGS

GATE TO CATHODE (with 1 kΩ resistor between gate and cathode)

Voltages

Forward peak voltage	V_{FGM}	max.	10	V
Reverse peak voltage	V_{RGM}	max.	5	V

Current

Forward peak current	I_{FGM}	max.	0.2	A

Power dissipation

Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	0.05	W
Peak power dissipation	P_{GM}	max.	0.5	W

TEMPERATURES

Storage temperature	T_{stg}		-55 to +125	°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to case	$R_{th\ j\text{-}c}$	=	10	°C/W
From junction to ambient	$R_{th\ j\text{-}a}$	=	200	°C/W
Transient thermal resistance (t = 10 ms)	$Z_{th\ j\text{-}c}$	=	2.5	°C/W

CHARACTERISTICS

ANODE TO CATHODE

			BTX18-100	200	300	400	500	
Voltages								
On-state voltage I_T = 1.0 A; T_j = 25 °C	V_T	<	1.5	1.5	1.5	1.5	1.5	V[1]
Rate of rise of off-state voltage that will not trigger any device R_{GK} = 1 kΩ; T_j = 125 °C	$\frac{dV_D}{dt}$		See page 6					
Currents								
Peak reverse current $V_{RM} = V_{RWMmax}$; T_j = 125 °C	I_{RM}	<	800	400	275	200	160	μA
Peak off-state current $V_{DM} = V_{DWMmax}$; T_j = 125 °C	I_{DM}	<	800	400	275	200	160	μA

---

1) V_T is measured along the leads at 1 cm from the case.

CHARACTERISTICS (continued)

Latching current; T_j = 125 °C	I_L	typ.	10	mA
Holding current; T_j = 25 °C	I_H	<	5.0	mA 1)

GATE TO CATHODE

Voltages

Voltage that will trigger all devices; T_j = 25 °C	V_{GT}	>	2.0	V
Voltage that will not trigger any device; T_j = 125 °C	V_{GD}	<	200	mV

Current

Current that will trigger all devices; T_j = 25 °C	I_{GT}	>	5.0	mA

SWITCHING CHARACTERISTICS

Turn off time when switched from

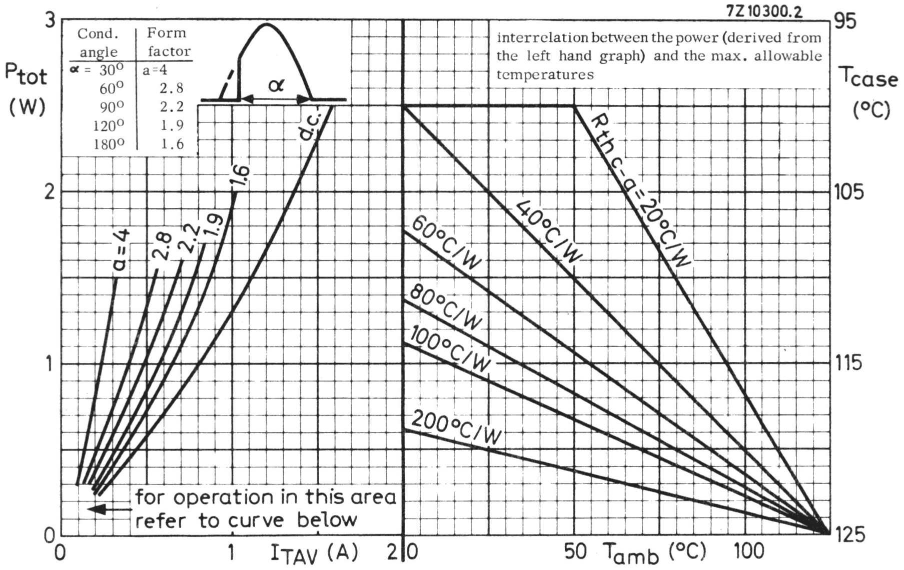
I_T = 300 mA to I_R = 175 mA; T_j = 25 °C	t_q	typ.	20	µs
T_j = 125 °C	t_q	typ.	35	µs

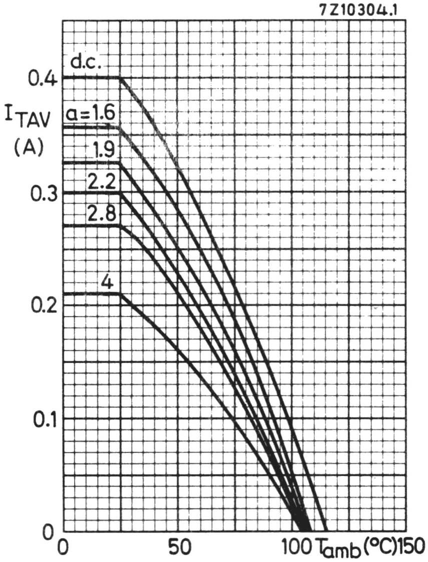
NOTES

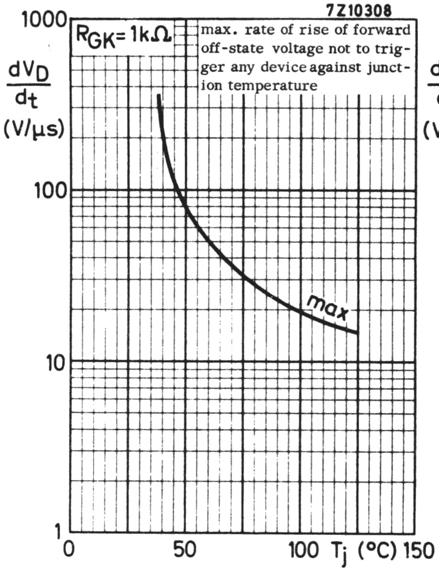
1. When using a soldering iron the thyristor may be soldered directly into the circuit, but the heat conduction to the junction should be kept to a minimum by using a thermal shunt.
2. Thyristors may be dip soldered at a solder temperature of 245 °C, for a maximum soldering time of 5 seconds. The case temperature during dip soldering must not at any time exceed the maximum storage temperature. These recommendations apply to a thyristor mounted flush on a board with punched-through holes, or spaced 1.5 mm above a board having plated-through holes.
3. Care should be taken not to bend the leads nearer than 1.5 mm from the seal.

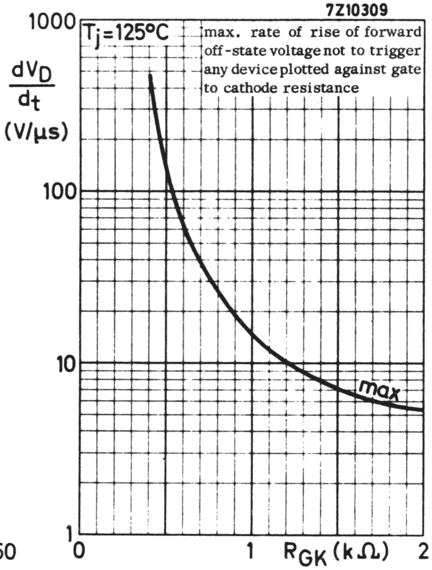
---

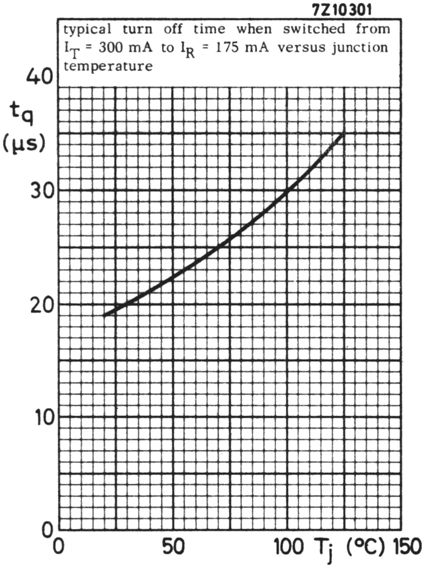
1) Measured under the following conditions: Anode supply voltage = +6.0 V.
Initial on-state current after gate triggering = 50 mA.
The current is reduced until the device turns of.

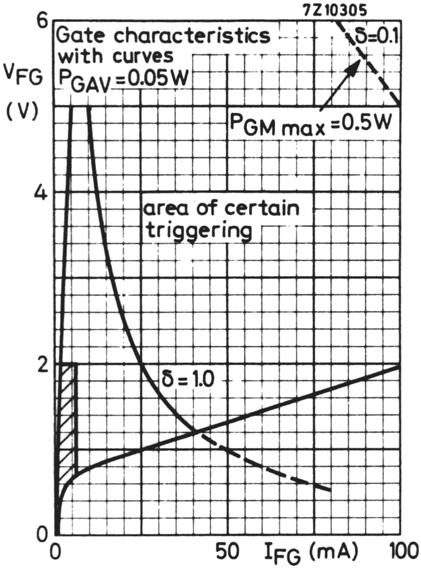

7Z10300.2
Ptot (W)
0
1
2
3
Cond. angle
Form factor
α = 30° a=4
60° 2.8
90° 2.2
120° 1.9
180° 1.6
α
d.c.
1.6
1.9
2.2
2.8
a=4
for operation in this area refer to curve below
0
1
ITAV (A)
2
interrelation between the power (derived from the left hand graph) and the max. allowable temperatures
Rth c-a=20°C/W
40°C/W
60°C/W
80°C/W
100°C/W
200°C/W
0
50
Tamb (°C)
100
Tcase (°C)
95
105
115
125

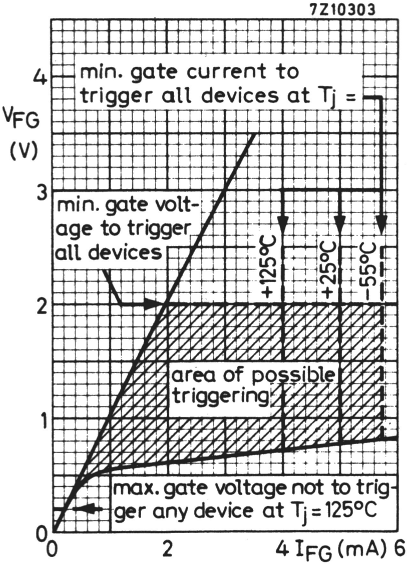

7Z10304.1
ITAV (A)
0
0.1
0.2
0.3
0.4
d.c.
a=1.6
1.9
2.2
2.8
4
0
50
100
Tamb (°C)
150

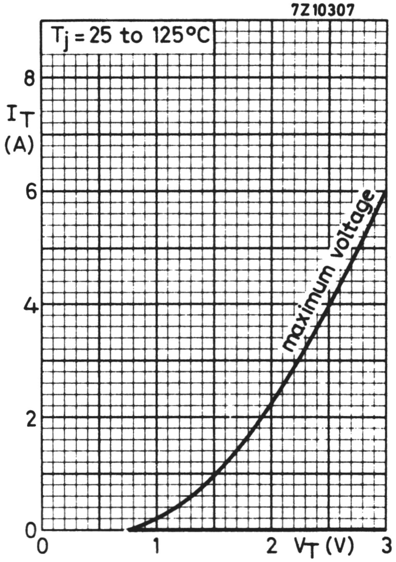

7Z10308
R_{GK} = 1kΩ
max. rate of rise of forward off-state voltage not to trigger any device against junction temperature
dV_D/dt (V/μs)
1000
100
10
1
0
50
100
150
T_j (°C)
max

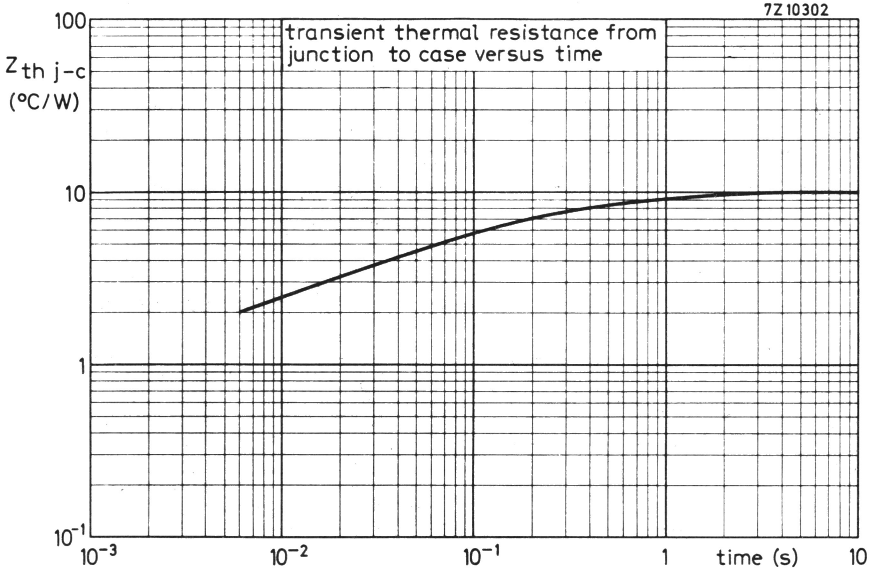

7Z10309
T_j = 125°C
max. rate of rise of forward off-state voltage not to trigger any device plotted against gate to cathode resistance
dV_D/dt (V/μs)
1000
100
10
1
0
1
2
R_{GK} (kΩ)
max

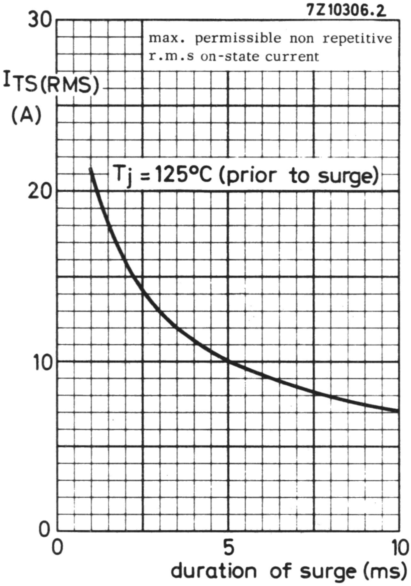

7Z10301
typical turn off time when switched from I_T = 300 mA to I_R = 175 mA versus junction temperature
t_q (μs)
40
30
20
10
0
0
50
100
150
T_j (°C)


7Z10305
Gate characteristics with curves P_{GAV} = 0.05 W
δ = 0.1
$P_{GM\,max}$ = 0.5 W
V_{FG} (V)
area of certain triggering
δ = 1.0
I_{FG} (mA)
0
2
4
6
50
100


7Z10303
min. gate current to trigger all devices at T_j =
V_{FG} (V)
min. gate voltage to trigger all devices
+125°C
+25°C
−55°C
area of possible triggering
max. gate voltage not to trigger any device at T_j = 125°C
I_{FG} (mA)
0
1
2
3
4
6


7Z10307
T_j = 25 to 125°C
I_T (A)
maximum voltage
V_T (V)
0
2
4
6
8
1
3


7Z10302
transient thermal resistance from junction to case versus time
$Z_{th\ j-c}$
(°C/W)
100
10
1
10^{-1}
10^{-3}
10^{-2}
10^{-1}
1
time (s)
10


7Z10306.2
max. permissible non repetitive r.m.s on-state current
$I_{TS(RMS)}$
(A)
T_j = 125°C (prior to surge)
30
20
10
0
0
5
10
duration of surge (ms)

CONTROLLED AVALANCHE THYRISTORS

These types have been superseded by the BTW47series

CONTROLLED AVALANCHE THYRISTORS

BTX37series: this type has been superseded by the BTW24series

BTX38series: this type has been superseded by the BTW23series

SILICON THYRISTORS

P-gate silicon thyristors in a metal envelope with ceramic insulation. They are intended for power control and power switching applications. The series consists of 5 reverse **polarity types (anode to stud)** BTX41-800R to BTX41-1600R. Together with the watercooled heatsink 56311 they are specially suited for welding.

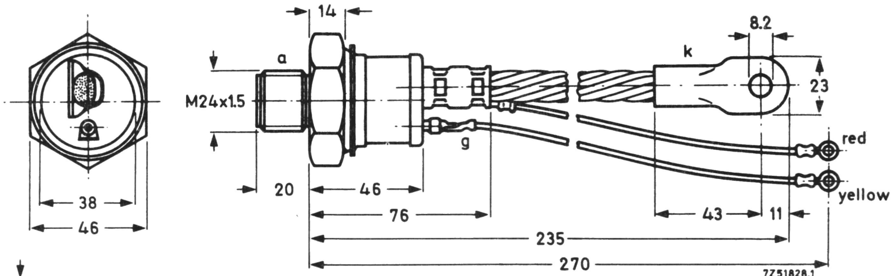
QUICK REFERENCE DATA

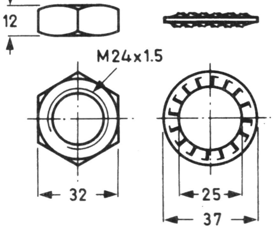
	BTX41 -	800R	1000R	1200R	1400R	1600R	
$V_{DWM} = V_{RWM}$	max.	800	1000	1200	1400	1600	V
$V_{DRM} = V_{RRM}$	max.	800	1000	1200	1400	1600	V

Average on-state current up to $T_{mb} = 65\ ^{o}C$	I_{TAV}	max.	250	A
at $T_{mb} = 85\ ^{o}C$	I_{TAV}	max.	160	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	400	A
Non repetitive peak on-state current; t = 10 ms	I_{TSM}	max.	5500	A
Rate of rise of on-state current	$\frac{dI_T}{dt}$	max.	30	A/µs
Rate of rise of off-state voltage that will not trigger any device exponential up to $\frac{2}{3} V_{DRMmax}$	$\frac{dV_D}{dt}$	<	20	V/µs
On request	$\frac{dV_D}{dt}$	up to	200	V/µs

MECHANICAL DATA

Dimensions in mm





Net weight: 530 g

Torque on nut: min. 300 kg cm
(30 Newton metres)
max. 400 kg cm
(40 Newton metres)

Diameter of clearance hole: max. 25 mm
Heatsinks available: 56284
56311 (for welding)

All information applies to frequencies up to 400 Hz.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

ANODE TO CATHODE

Voltages 1)		BTX41-800R	1000R	1200R	1400R	1600R	
Continuous voltages $V_D = V_R$	max.	800	1000	1200	1400	1600	V
Crest working voltages $V_{DWM} = V_{RWM}$	max.	800	1000	1200	1400	1600	V
Repetitive peak voltages $V_{DRM} = V_{RRM}$	max.	800	1000	1200	1400	1600	V
Non repetitive peak voltages ($t \leq 10$ ms) $V_{DSM} = V_{RSM}$	max.	900	1200	1400	1600	1800	V

Currents 2)

Average on-state current (averaged over any 20 ms period) up to $T_{mb} = 65\,^{\circ}C$	I_{TAV}	max.	250	A
at $T_{mb} = 85\,^{\circ}C$	I_{TAV}	max.	160	A
On-state current (d.c.)	I_T	max.	400	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	400	A
Repetitive peak on-state current	I_{TRM}	max.	2500	A
Non repetitive peak on-state current ($t = 10$ ms; half sine wave) $T_j = 110\,^{\circ}C$ prior to surge	I_{TSM}	max.	5500	A
I squared t for fusing ($t = 10$ ms)	I^2t	max.	150000	A^2s
Rate of rise of on-state current	$\frac{dI_T}{dt}$	max.	30	A/μs

GATE TO CATHODE

Forward peak voltage	V_{FGM}	max.	6	V
Reverse peak voltage	V_{RGM}	max.	5	V

Current

Forward peak current	I_{FGM}	max.	3	A

Power dissipation

Average power dissipation	P_{GAV}	max.	2	W
Peak power dissipation	P_{GM}	max.	10	W

TEMPERATURES

Storage temperature	T_{stg}		−40 to +125	°C
Operating junction temperature	T_j	max.	110	°C

---

1) These ratings apply to a gate voltage range of V_{RGMmax} to V_{GDmax}.

2) The temperature of the cathode cable lug should be kept below 105 °C.

THERMAL RESISTANCE

From junction to mounting base $R_{th\ j\text{-}mb}$ = 0.12 °C/W

From mounting base to heatsink with heatsink compound, e.g. Dow Corning 340 $R_{th\ mb\text{-}h}$ = 0.03 °C/W

Transient thermal impedance from junction to mounting base (t = 10 ms) $Z_{th\ j\text{-}mb}$ = 0.015 °C/W

CHARACTERISTICS

T_j = 110 °C unless otherwise specified

ANODE TO CATHODE

Voltages

	BTX41 - 800R	1000R	1200R	1400R	1600R	
On-state voltage at I_T = 600 A	V_T < 1.5	1.5	1.5	1.6	1.6	V

Rate of rise of off-state voltage that will not trigger any device

exponential up to $\frac{2}{3} V_{DRMmax}$ $\frac{dV_D}{dt}$ < 20 V/μs

On request $\frac{dV_D}{dt}$ up to 200 V/μs

Currents

Peak reverse current
$V_R = V_{RWMmax}$ I_{RM} < 10 mA

Peak off-state current
$V_D = V_{DWMmax}$ I_{DM} < 10 mA

Holding current at T_j = 25 °C I_H < 150 mA

GATE TO CATHODE

Voltages

Gate trigger voltage

V_D = 6 V; T_j = 25 °C V_{GT} > 2.5 V

Gate non-trigger voltage

$V_D = V_{DRMmax}$ V_{GD} < 0.15 V

Currents

Gate trigger current

V_D = 6 V; T_j = 25 °C I_{GT} > 250 mA

V_D = 6 V; T_j = −40 °C I_{GT} > 300 mA

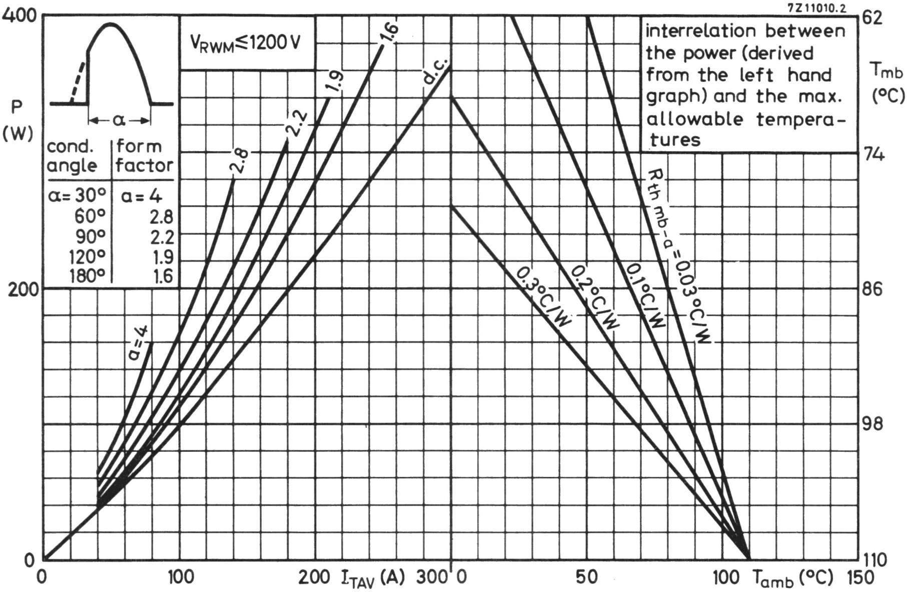
SWITCHING CHARACTERISTICS

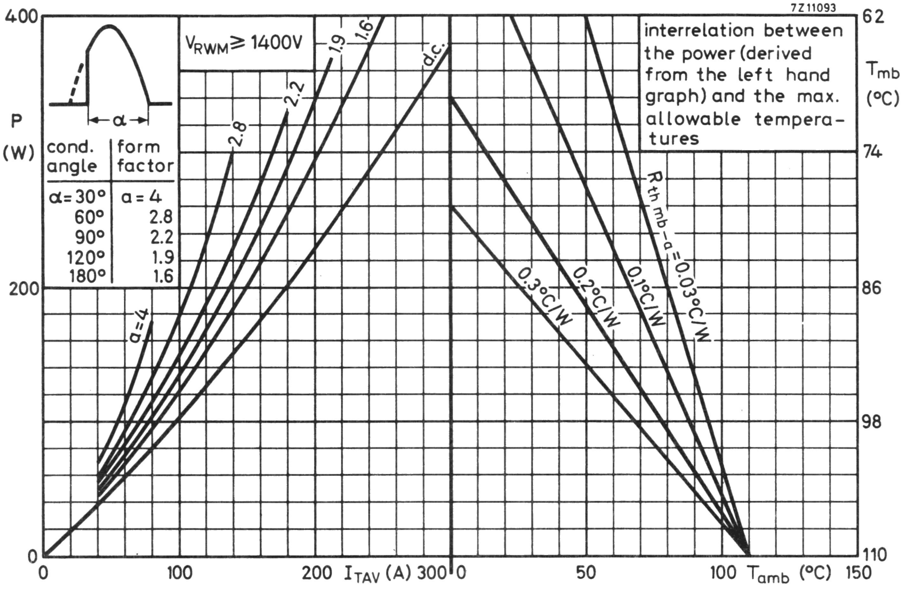
Turn on time when switched from

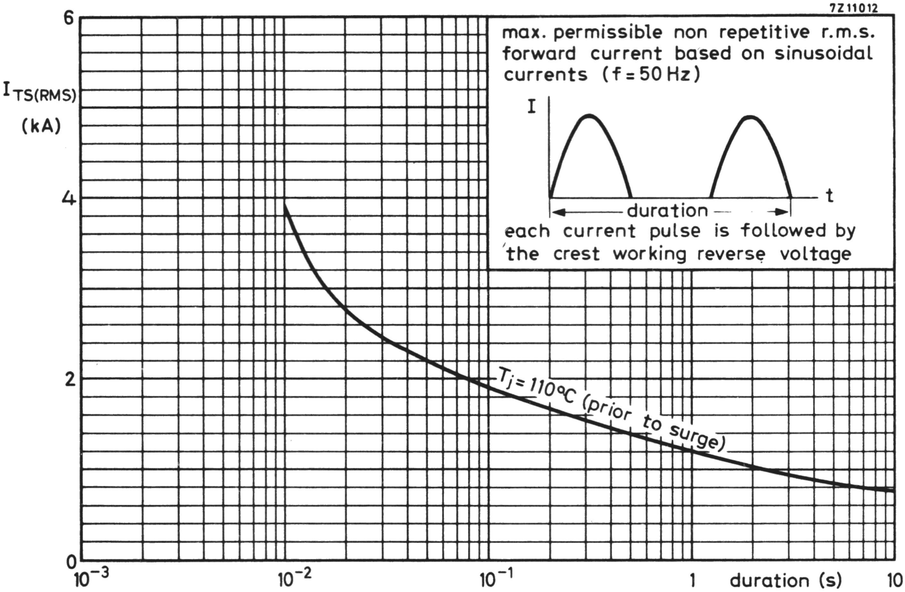
V_D = 100 V to I_T = 250 A; I_G = 1.5 A; $\frac{dI_G}{dt}$ = 3 A/μs; T_j = 25 °C	t_{on}	<	20	μs

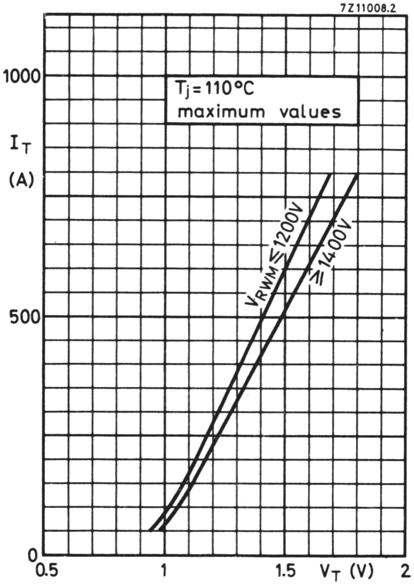
Turn off time when switched from

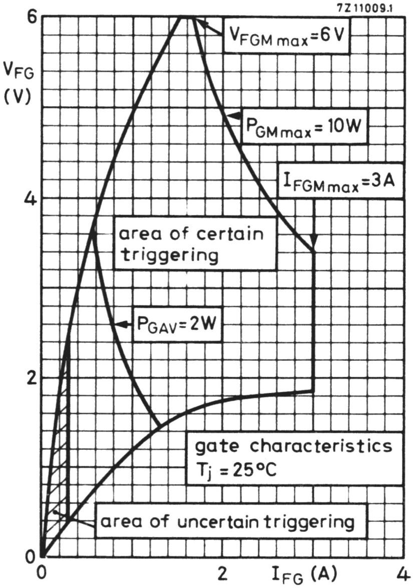
I_T = 50 A to I_R = 25 A $\frac{dV_D}{dt}$ = 20 V/μs; $-\frac{dI_T}{dt}$ = 20 A/μs; T_j = 110 °C	t_{off}	typ.	200	μs


7Z11010.2
400
200
0
P
(W)
α
cond. angle | form factor
α = 30° | a = 4
60° | 2.8
90° | 2.2
120° | 1.9
180° | 1.6
V_RWM ≤ 1200 V
1.6
1.9
2.2
2.8
d.c.
a = 4
0
100
200
I_TAV (A)
300
0
50
100
T_amb (°C)
150
interrelation between the power (derived from the left hand graph) and the max. allowable temperatures
R_th mb-a = 0.03°C/W
0.1°C/W
0.2°C/W
0.3°C/W
62
74
86
98
110
T_mb (°C)

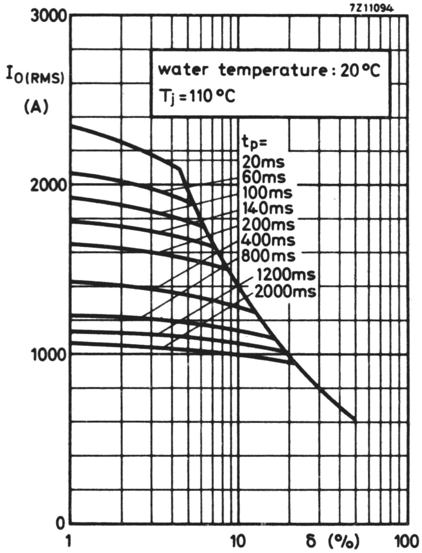

7Z11093
400
200
0
P
(W)
α
cond. angle | form factor
α = 30° | a = 4
60° | 2.8
90° | 2.2
120° | 1.9
180° | 1.6
V_RWM ≥ 1400 V
1.6
1.9
2.2
2.8
d.c.
a = 4
0
100
200
I_TAV (A)
300
0
50
100
T_amb (°C)
150
interrelation between the power (derived from the left hand graph) and the max. allowable temperatures
R_th mb-a = 0.03°C/W
0.1°C/W
0.2°C/W
0.3°C/W
62
74
86
98
110
T_mb (°C)

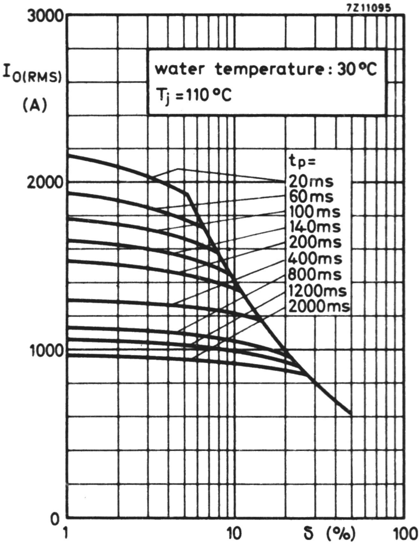

7Z11012
max. permissible non repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz)
I
t
duration
each current pulse is followed by the crest working reverse voltage
$I_{TS(RMS)}$ (kA)
6
4
2
0
10^{-3}
10^{-2}
10^{-1}
1
duration (s)
10
T_j = 110 °C (prior to surge)

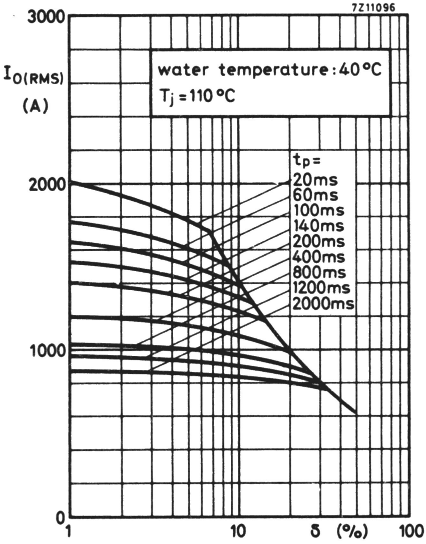

7Z11008.2
T_j = 110 °C
maximum values
I_T (A)
1000
500
0
$V_{RWM} \leq 1200V$
$\geq 1400V$
0.5
1
1.5
V_T (V)
2

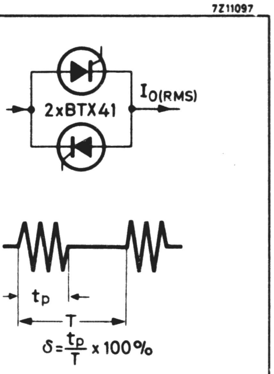

7Z11009.1
V_{FG} (V)
6
4
2
0
$V_{FGM\,max}$ = 6 V
$P_{GM\,max}$ = 10 W
$I_{FGM\,max}$ = 3 A
area of certain triggering
P_{GAV} = 2 W
gate characteristics
T_j = 25 °C
area of uncertain triggering
0
2
I_{FG} (A)
4

Intermittent overload capability of 2 BTX41 thyristors in antiparallel connection in a single phase a.c. control circuit (e.g. welding).



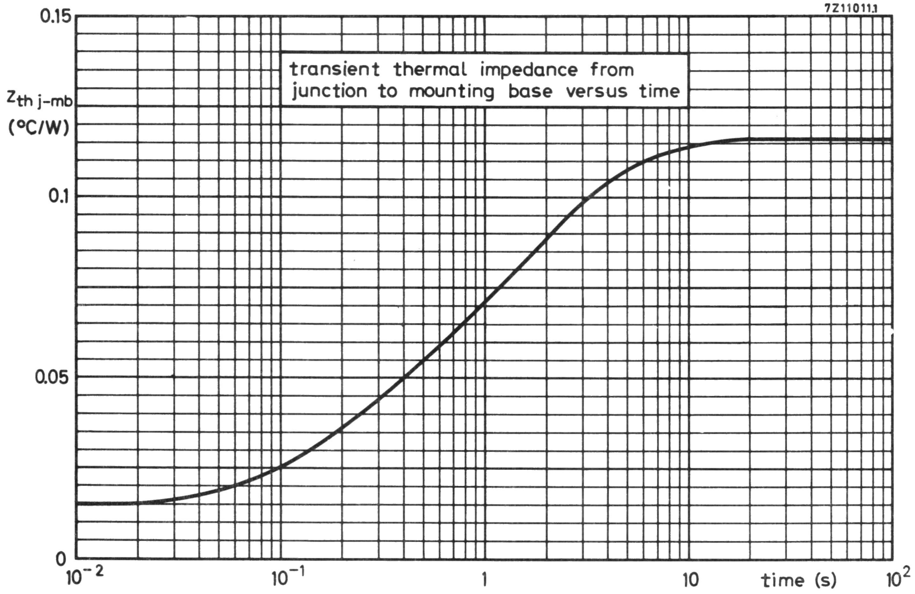






$\delta = \frac{t_p}{T} \times 100\%$

Notes:
conduction angle: 360°
heatsink : 56311
water flow : 4 ℓ/min


7Z11011.1
transient thermal impedance from junction to mounting base versus time
$Z_{th\ j-mb}$
(°C/W)
0.15
0.1
0.05
0
10^{-2}
10^{-1}
1
10
time (s)
10^{2}

CONTROLLED AVALANCHE THYRISTORS

BTX47series: this type has been superseded by the BTW47series

BTX48series: this type has been superseded by the BTW92series

BTX49series: this type has been superseded by the BTW23series

CONTROLLED AVALANCHE THYRISTORS

This type has been superseded by the BTW23series

CONTROLLED AVALANCHE THYRISTORS

This type has been superseded by the BTY79series

SILICON THYRISTORS

BTX81series: this type has been superseded by the BTW92series

----

BTX82series: this type has been superseded by the BTW24series

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CONTROLLED AVALANCHE THYRISTORS WITH HIGH dV/dt and dI/dt CAPABILITIES

This type has been superseded by the BTW92series

TRIACS

The BTX94series is a range of bi-directional triode thyristors (triacs), in a TO-48 metal envelope, intended for industrial a.c. power control applications (a.o. furnace temperature control, static switching and motor control).
The series consists of the types BTX94-400 to BTX94-1200.

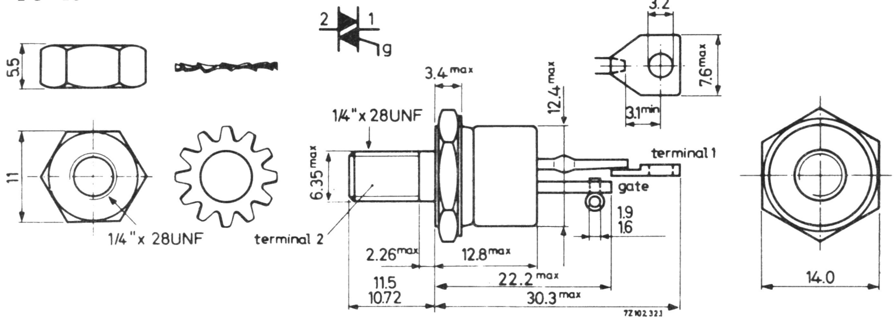
QUICK REFERENCE DATA

			BTX94-400	500	600	800	1000	1200	
Crest working off-state voltage	V_{DWM}	max.	400	500	600	800	1000	1200	V
Repetitive peak off-state voltage	V_{DRM}	max.	400	500	600	800	1000	1200	V
Breakover voltage	$V_{(BO)}$	>	500	600	700	900	1100	1300	V

R.M.S. on-state current at T_{mb} = 85 °C	$I_{T(RMS)}$	max.	25	A
Non-repetitive peak on-state current t = 10 ms; T_j = 125 °C prior to surge	I_{TSM}	max.	250	A
Junction temperature	T_j	max.	125	A
Rate of rise of on-state current after triggering	$\frac{dI_T}{dt}$	max.	50	A/μs
Rate of rise of off-state voltage that will not trigger any device	$\frac{dV_D}{dt}$	<	100	V/μs
Rate of rise of commutating voltage that will not trigger any device	$\frac{dV_D}{dt}$	<	30	V/μs

MECHANICAL DATA Dimensions in mm

TO-48


5.5
11
1/4"x 28UNF
2
1
g
3.4 max
1/4"x 28UNF
6.35 max
terminal 2
2.26 max
12.8 max
11.5
10.72
22.2 max
30.3 max
12.4 max
4.2
3.2
7.6 max
3.1 min
terminal 1
gate
1.9
1.6
14.0
7Z102323

Net weight: 15 g
Diameter of clearance hole: max. 6.5 mm
Accessories supplied on request: 56264A

Torque on nut: min. 17 kg cm
(1.7 Newton-metres)
max. 35 kg cm
(3.5 Newton-metres)

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages (in either direction) 1)		BTX94-400	500	600	800	1000	1200	
Crest working off-state voltage	V_{DWM} max.	400	500	600	800	1000	1200	2)
Repetitive peak off-state voltage ($\delta \leq 0.01$)	V_{DRM} max.	400	500	600	800	1000	1200	2)

Currents (in either direction)

R.M.S. on-state current (conduction angle 360°) at $T_{mb} = 85\,^{\circ}C$	$I_{T(RMS)}$	max.	25	A
Repetitive peak on-state current	I_{TRM}	max.	100	A
Non-repetitive peak on-state current $T_j = 125\,^{\circ}C$ prior to surge; t = 10 ms; half sine-wave	I_{TSM}	max.	250	A
t = 20 ms; full sine-wave	I_{TSM}	max.	250	A
I^2t for fusing (t = 10 ms)	I^2t	max.	312	A^2s
Rate of rise of on-state current after triggering with I_{GT} to I_T = 100 A	$\frac{dI_T}{dt}$	max.	50	A/µs

GATE TO TERMINAL 1

Power dissipation

Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	1	W
Peak power dissipation	P_{GM}	max.	5	W

TEMPERATURES

Storage temperature	T_{stg}		−55 to 125	°C
Junction temperature	T_j	max.	125	°C

---

1) To ensure thermal stability: $R_{th\ j\text{-}a} < 3.5\,^{\circ}C/W$ (a.c.)

2) Higher off-state voltages may be applied without damage, but at voltages higher than the minimum forward breakover voltage (see page 3) the triac may switch into the on-state. The rate of rise of on-state current should not exceed 50 A/µs

THERMAL RESISTANCE

From junction to mounting base full cycle operation	$R_{th\ j\text{-}mb}$	=	1.0	°C/W
half cycle operation	$R_{th\ j\text{-}mb}$	=	2.0	°C/W
From mounting base to heatsink with heatsink compound	$R_{th\ mb\text{-}h}$	=	0.2	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.12	°C/W

CHARACTERISTICS (Polarities, pos. or neg., are indentified with respect to T_1)

Voltages (in either direction)		BTX94-400	500	600	800	1000	1200	
Breakover voltage up to $T_j = 125\,^{\circ}C$	$V_{(BO)}$ >	500	600	700	900	1100	1300	V

On-state voltage $I_T = 50\ A$; $T_j = 25\,^{\circ}C$	V_T	<	2.3	V
Rate of rise of off-state voltage that will not trigger any device; $T_j = 125\,^{\circ}C$	$\frac{dV_D}{dt}$	<	100	V/µs
Rate of rise of commutating voltage that will not trigger any device $-dI/dt = 50\ A/ms$; $T_j = 125\,^{\circ}C$	$\frac{dV_D}{dt}$	<	30	V/µs

Currents (in either direction)

		BTX94-400	500	600	800	1000	1200	
Peak off-state current $V_{DM} = V_{DWMmax}$; $T_j = 125\,^{\circ}C$	I_{DM} <	9	9	9	9	8	7	mA

SWITCHING CHARACTERISTICS

Turn-on time ($t_{on} = t_d + t_r$) when switched from

$V_D = V_{DWMmax}$ to $I_T = 10\ A$ $I_G = I_{GT}$; $T_j = 25\,^{\circ}C$	t_{on}	typ.	1.5	µs

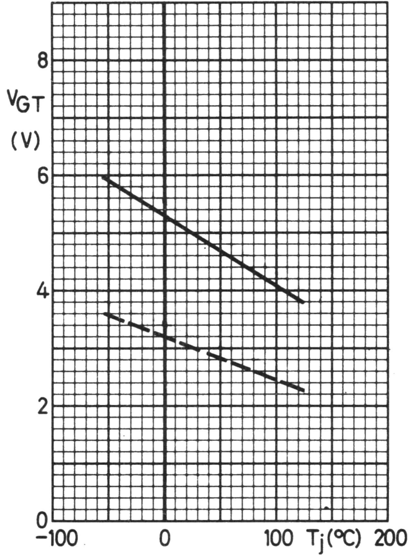
GATE TO TERMINAL 1

Voltage and Current

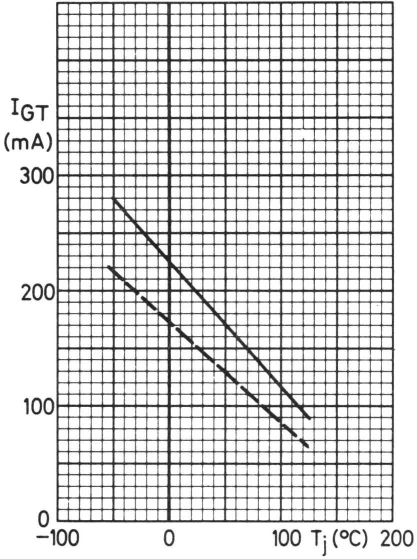
that will trigger all devices
$T_j = 25\,^{o}C$

			T2 pos.	T2 neg.	
G pos.	V_{GT}	>	3.0	5.0	V
	I_{GT}	>	150	200	mA
G neg.	$-V_{GT}$	>	3.0	3.0	V
	$-I_{GT}$	>	150	150	mA

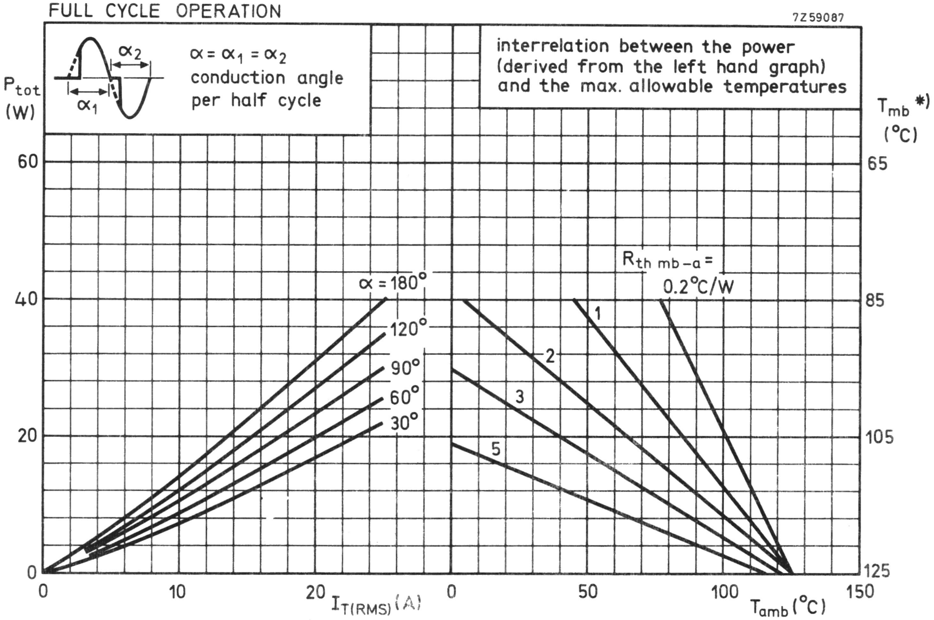
minimum trigger voltage versus junction temperature



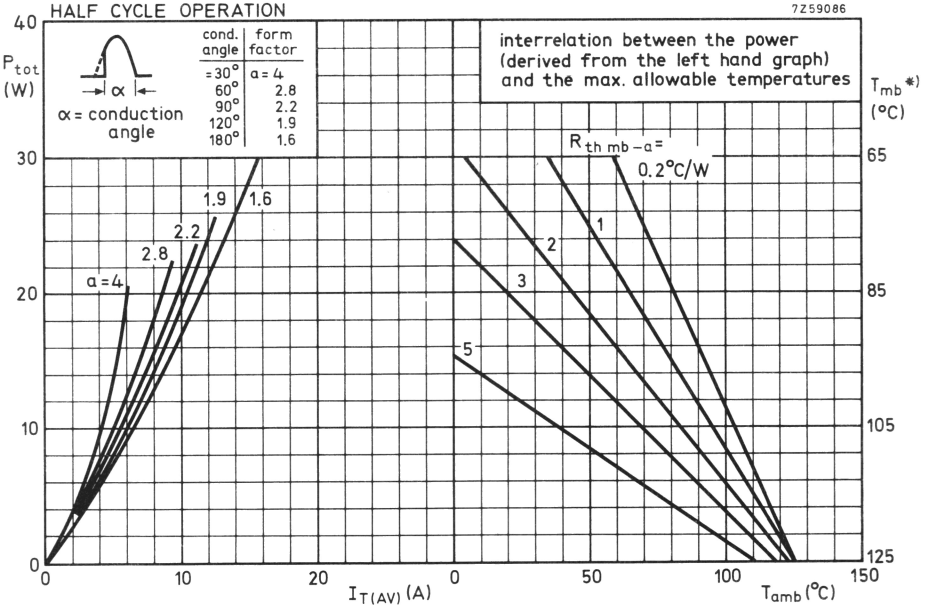
minimum trigger current versus junction temperature



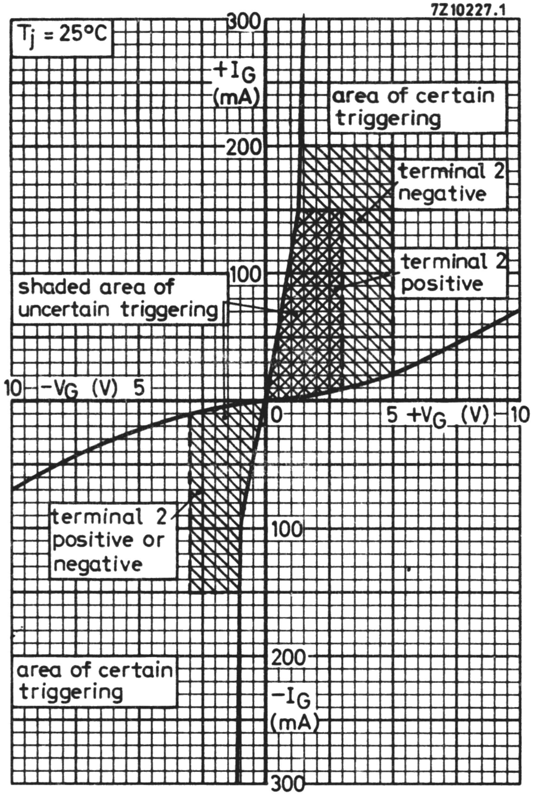
—— terminal 2 negative with respect to 1; gate positive with respect to terminal 1.
---- all other conditions.



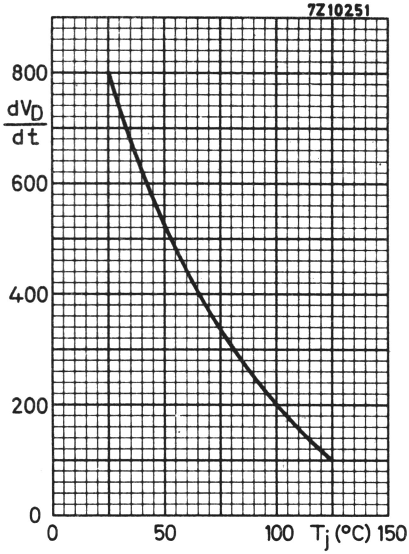
*) T_{mb} – scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leq 2.5$ °C/W

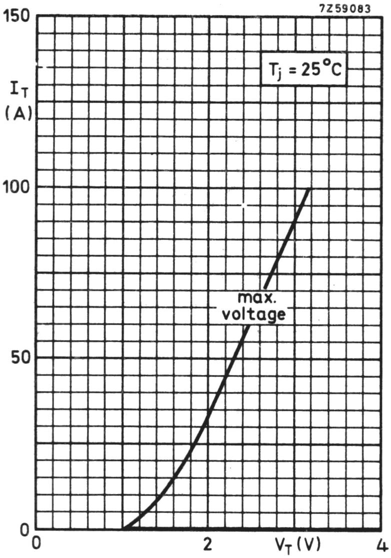


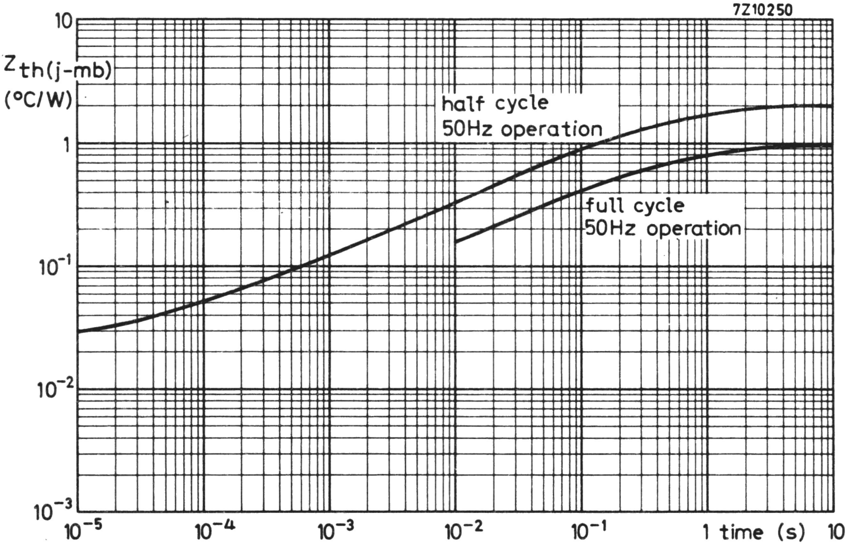
*) T_{mb} – scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leq 1.5$ °C/W

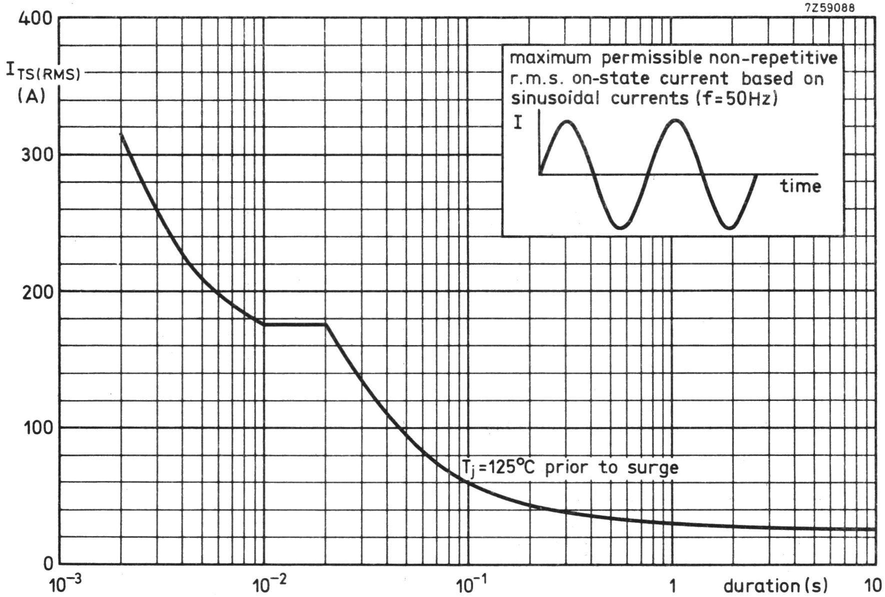

7Z10227.1
T_j = 25°C
300
+I_G
(mA)
200
100
area of certain triggering
terminal 2 negative
terminal 2 positive
shaded area of uncertain triggering
10
−V_G (V)
5
0
5
+V_G (V)
10
terminal 2 positive or negative
100
200
area of certain triggering
−I_G
(mA)
300

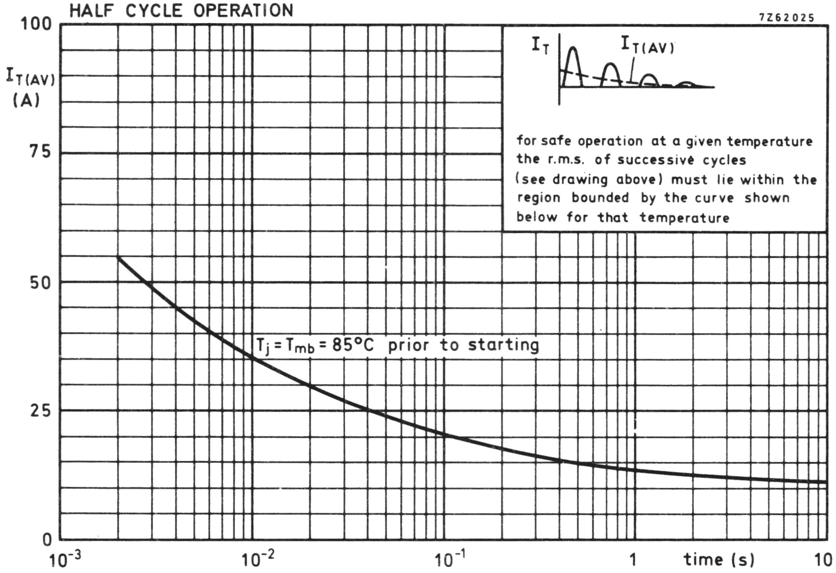
max. rate of rise of off-state voltage
that will not trigger any device.
(non-commutated condition)

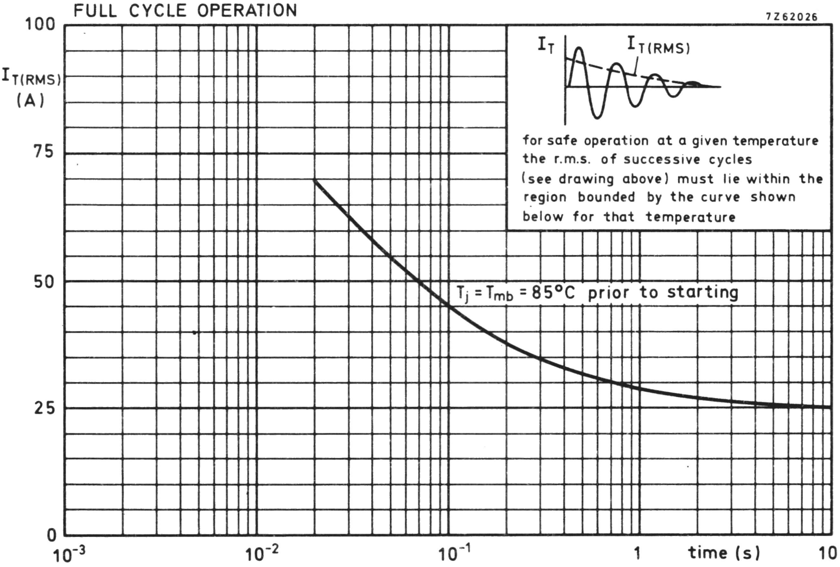







7Z59088
400
$I_{TS(RMS)}$
(A)
300
200
100
0
10^{-3}
10^{-2}
10^{-1}
1
duration (s)
10
maximum permissible non-repetitive r.m.s. on-state current based on sinusoidal currents (f=50Hz)
I
time
T_j=125°C prior to surge


HALF CYCLE OPERATION
7Z62025
100
$I_{T(AV)}$
(A)
75
50
25
0
10^{-3}
10^{-2}
10^{-1}
1
time (s)
10
I_T
$I_{T(AV)}$
for safe operation at a given temperature the r.m.s. of successive cycles (see drawing above) must lie within the region bounded by the curve shown below for that temperature
$T_j = T_{mb} = 85°C$ prior to starting


FULL CYCLE OPERATION
7Z62026
100
$I_{T(RMS)}$
(A)
75
50
25
0
10^{-3}
10^{-2}
10^{-1}
1
time (s)
10
I_T
$I_{T(RMS)}$
for safe operation at a given temperature the r.m.s. of successive cycles (see drawing above) must lie within the region bounded by the curve shown below for that temperature
$T_j = T_{mb} = 85°C$ prior to starting

PULSE MODULATOR THYRISTORS

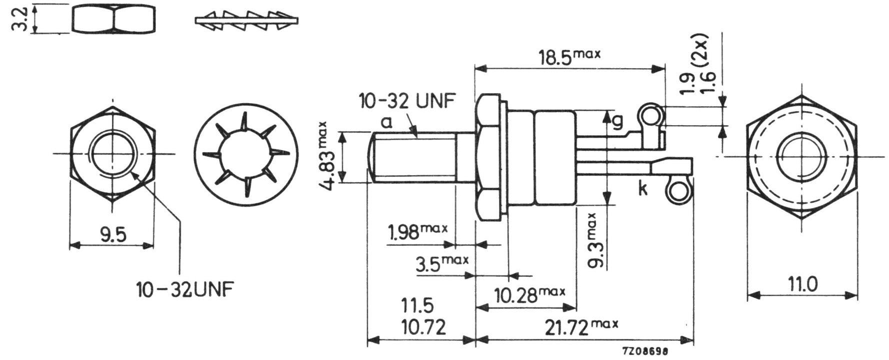
The BTX95series is a range of fast-switching, high voltage thyristors particularly designed for radar and other similar pulse modulator applications. They are capable of switching peak powers of up to 150 kW at frequencies up to 5 kHz. The series consists of reverse polarity types (anode to stud) BTX95-500R to BTX95-800R.

QUICK REFERENCE DATA

			BTX95-500R	600R	700R	800R	
Crest working reverse voltage	V_{RWM}	max.	250	300	350	400	V
Crest working off-state voltage	V_{DWM}	max.	500	600	700	800	V
Rise time I_{TM} = 40 A; T_j = 25 °C	t_r	<	375	300	250	220	ns
Repetitive peak forward current	I_{TRM}	max.	300 A				
Junction temperature	T_j	max.	105 °C				
Rate of rise of on-state current	$\frac{dI_T}{dt}$	max.	1000 A/μs				

MECHANICAL DATA Dimensions in mm

TO-64


3.2
18.5max
1.9
1.6 (2x)
10-32 UNF
a
g
k
4.83max
9.5
10-32UNF
1.98max
3.5max
9.3max
10.28max
11.5
10.72
21.72max
11.0
7Z08698

Net weight: 7.5 g
Diameter of clearance hole: max. 5.2 mm
Accessories available: 56295, (56262A)

Torque on nut: min. 8 cm kg
(0.8 Newton-metres)
max. 17 cm kg
(1.7 Newton-metres)

All information applies to frequencies up to 5 kHz.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

ANODE TO CATHODE

Voltages [1]			BTX95-500R	600R	700R	800R	
Continuous reverse voltage	V_R	max.	250	300	350	400	V
Maximum crest working reverse voltage	V_{RWM}	max.	250	300	350	400	V
Continuous off-state voltage	V_D	max.	500	600	700	800	V
Crest working off-state voltage	V_{DWM}	max.	500	600	700	800	V

---

[1] To ensure thermal stability $R_{th\ j\text{-}a} \leq 7.5\,^{o}C/W$.

RATINGS (continued)

Currents

R.M.S. on-state current	$I_{T(RMS)}$	max.	15	A
Repetitive peak on-state current square wave; t ≤ 2μs	I_{TRM}	max.	100	A
half sine wave: t ≤ 2μs	I_{TRM}	max.	200	A
half sine wave with saturable reactor priming and delay (10 A for 2μs) t ≤ 12μs (see also page 7)	I_{TRM}	max.	300	A
Rate of rise of on-state current after triggering with I_G = 100 mA	$\frac{dI_T}{dt}$	max.	1000	A/μs
after breakover	$\frac{dI_T}{dt}$	max.	50	A/μs

Power dissipation

Average on-state power dissipation	$P_{T(AV)}$	max.	15	W
Repetitive peak on-state power dissipation without saturable reactor; square wave operation	P_{TRM}	max.	15	kW

GATE TO CATHODE

Voltages

Forward peak voltage	V_{FGM}	max.	10	V
Reverse peak voltage	V_{RGM}	max.	5	V

Current

Forward peak current	I_{FGM}	max.	5	A

Power dissipation

Average power dissipation	$P_{G(AV)}$	max.	1	W
Peak power dissipation	P_{GM}	max.	20	W

OPERATING FREQUENCY

Operating frequency (see also page 5)	f	max.	5	kHz

TEMPERATURES

Storage temperature	T_{stg}		−55 to +125	°C
Operating junction temperature	T_j	max.	105	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	40	°C/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	3.0	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.5	°C/W

CHARACTERISTICS

ANODE TO CATHODE

On-state voltage

1. I_T = 10 A; T_j = 25 °C	V_T	<	3	V[1]
2. at 50 ns after 10% decay point of pulse forming network discharge to 40 A peak value I_G = 100 mA; T_j = 25 °C	V_T	<	200	V
3. at 250 ns after 10% decay as above T_j = 25 °C	V_T	<	70	V

Currents

		BTX95-500R	600R	700R	800R	
Peak reverse current $V_{RM} = V_{RWMmax}$; T_j = 105 °C	I_{RM}	< 3.0	2.5	2.0	2.0	mA
Peak off-state current $V_{DM} = V_{DWMmax}$; T_j = 105 °C	I_{DM}	< 6.0	5.0	4.0	3.5	mA

GATE TO CATHODE

Voltages

Voltage that will trigger all devices V_D = 6 V; T_j = 25 °C	V_{GT}	>	1.5	V
Voltage that will not trigger any device $V_D = V_{DRMmax}$; T_j = 105 °C	V_{GD}	<	150	mV

Current

Current that will trigger all devices V_D = 6 V; T_j = 25 °C	I_{GT}	>	50	mA

SWITCHING CHARACTERISTICS

Rise time

		BTX95-500R	600R	700R	800R	
I_{TM} = 40 A; T_j = 25 °C	t_r	< 375	300	250	220	ns

Turn off time when switched from

I_T = 40 A to I_R = 2 A; T_j = 105 °C $\frac{dV_D}{dt}$ = 20 V/µs linear ramp	t_q	<	50	µs

---

[1] Measured under pulsed conditions to avoid excessive dissipation.

OPERATING NOTES

Enhanced performance of the devices

The power loss curves on pages 6 and 7 are given on the basis of the device operating at its maximum permitted junction temperature of 105 °C, but significant improvement in performance can be obtained by a choice of heatsink to ensure that the junction is operating at a lower temperature. This is due to the following factors:

1. On-state forward voltage is lower at lower temperatures giving lower power losses in switching.
2. Turn-off time is lower at lower temperatures (curves on page 9), hence the maximum operating frequency can be increased above 5 kHz, assuming that the maximum power rating of the device is not exceeded.

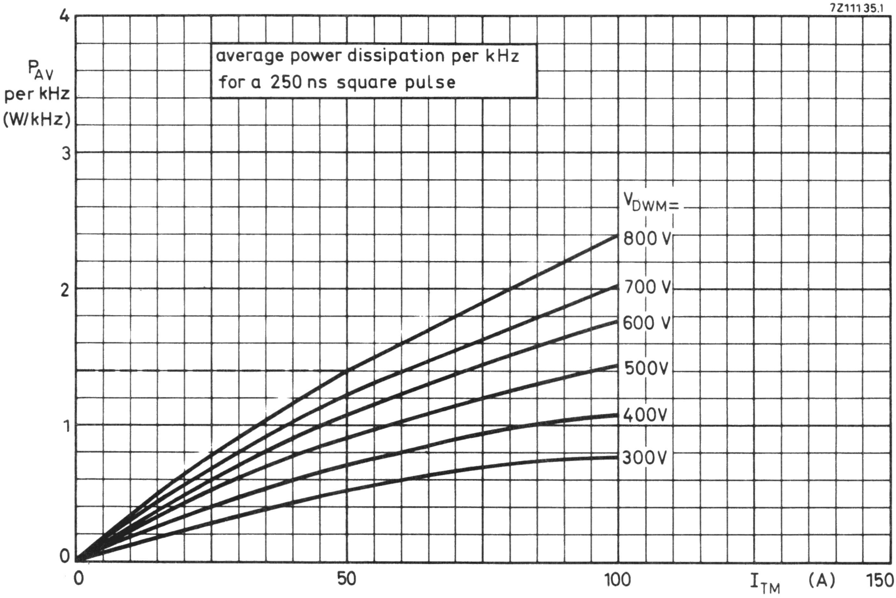
   therefore $f_{max} = \frac{1}{4\ t_q}$ in sinewave charging operation

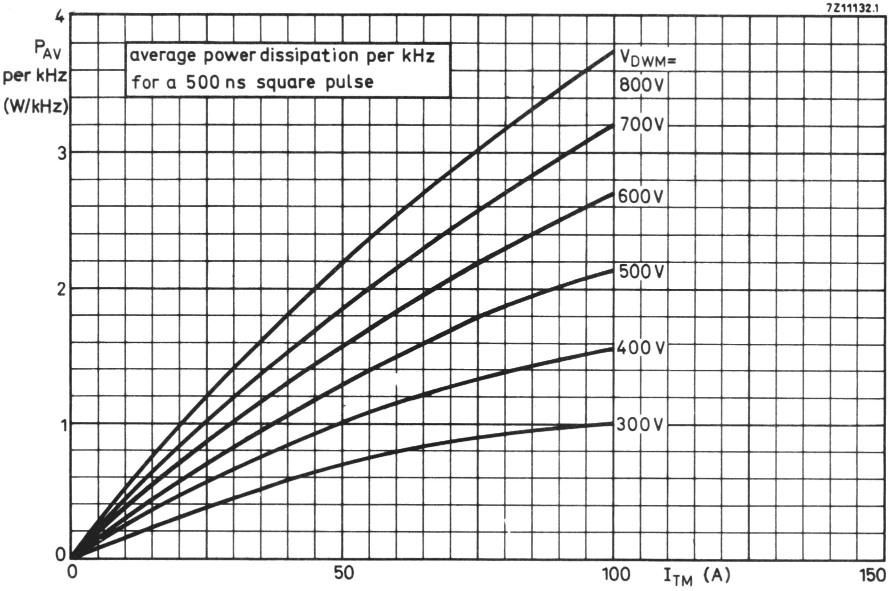
   This assumes that the requirements of dV/dt are met (see below)
3. The maximum operating frequency is also governed by the dV/dt capability of the thyristor, due to the enforced limitation on pulse forming network charging rate. Page 7 shows how dV/dt improves at lower temperatures.

   $$f_{max} \text{ is then given as } = \frac{dV/dt\ (V/\mu s) \times 10^6}{5.7 \times V_{Dmax}}$$

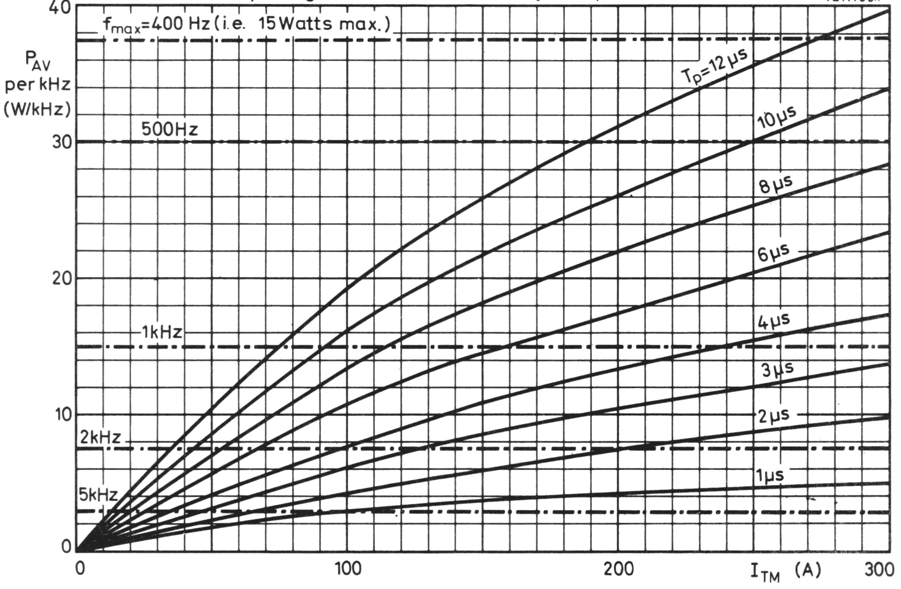
   where V_{Dmax} is the peak value of the off-state voltage to be switched.

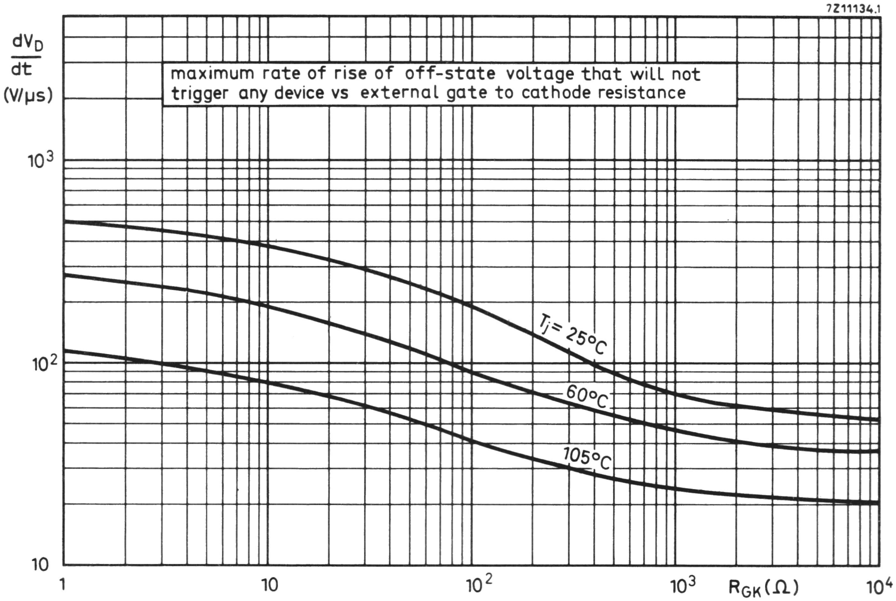
Both conditions 2 and 3 must apply simultaneously and the lower value found for f_{max} is the correct one to use.


7Z11135.1
P_{AV} per kHz (W/kHz)
4
3
2
1
0
average power dissipation per kHz
for a 250 ns square pulse
V_{DWM}=
800 V
700 V
600 V
500V
400V
300V
0
50
100
I_{TM} (A)
150

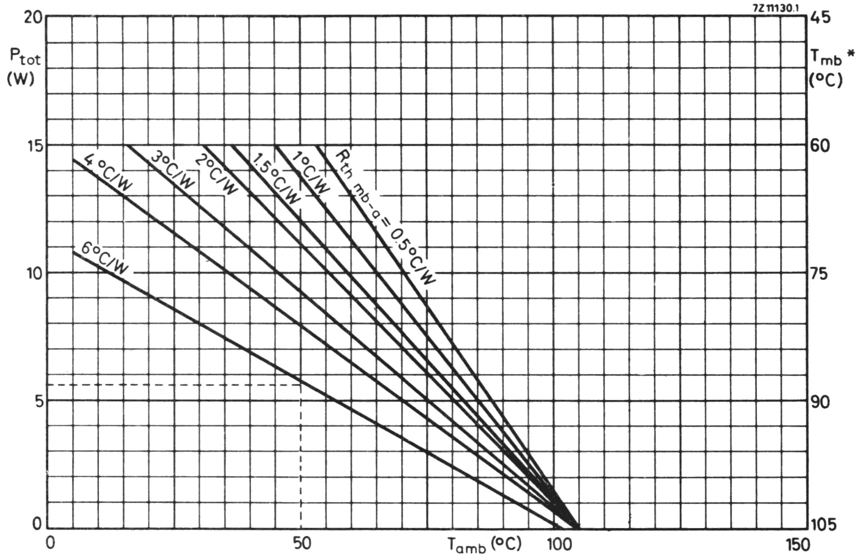

7Z11132.1
P_{AV} per kHz (W/kHz)
4
3
2
1
0
average power dissipation per kHz
for a 500 ns square pulse
V_{DWM}=
800V
700V
600V
500V
400V
300V
0
50
100
I_{TM} (A)
150

Average power dissipation per kHz for sinusoidal pulses when used with saturable reactor priming current of 10 A and delay of 2 μs





maximum rate of rise of off-state voltage that will not trigger any device vs external gate to cathode resistance



*)T_{mb}-scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leq 4.5\ ^{\circ}C/W$

Determination of the heatsink thermal resistance.

Example:

Assume a thyristor, operating without a delay reactor, switching square pulses.

Repetitive peak on-state current	I_{TRM}	=	50	A
Pulse duration	t_p	=	250	ns
Crest working voltage	V_{DWM}	=	800	V
Pulse frequency	f	=	4	kHz
Ambient temperature	T_{amb}	=	50	°C

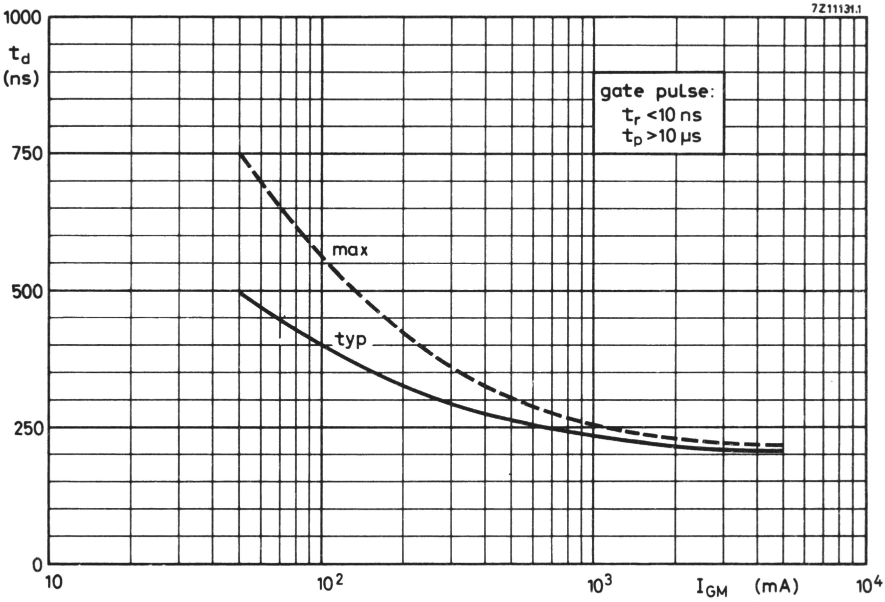
From the upper graph on page 5 it follows, that at I_{TRM} = 50 A and V_{DWM} = 800 V, the power loss per kHz = 1.4 W/kHz
The total power loss at f = 4 kHz: (4 x 1.4) W = 5.6 W

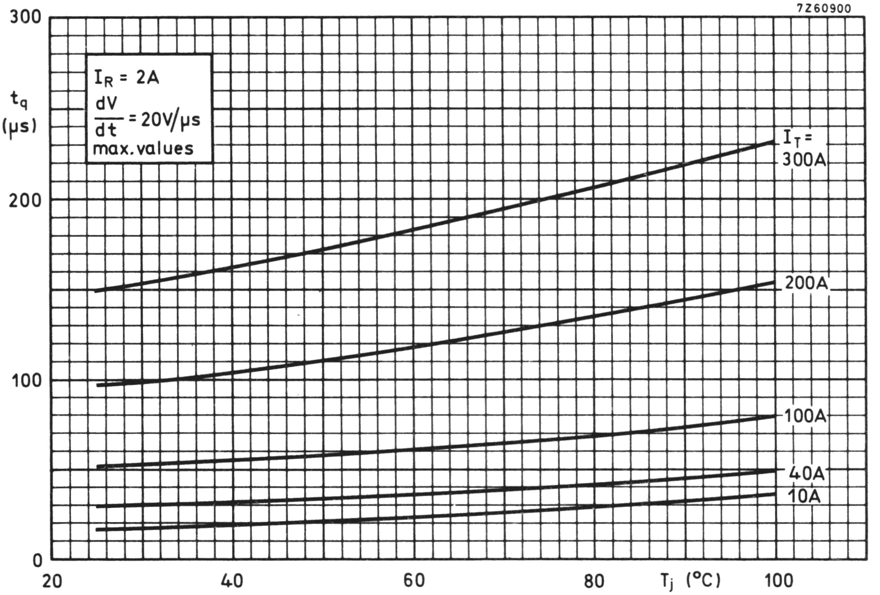
From the curve on this page, the required value of $R_{th\ mb-a}$ can be found.
At P_{tot} = 5.6 W and T_{amb} = 50 °C : $R_{th\ mb-a} \approx 6\ ^{\circ}C/W$.

The contact thermal resistance $R_{th\ mb-h}$ = 0.5 °C/W.

Hence the heatsink thermal resistance should be:

$$R_{th\ h-a} = R_{th\ mb-a} - R_{th\ mb-h} = (6-0.5)\ ^{\circ}C/W = 5.5\ ^{\circ}C/W.$$


7Z11131.1
1000
t_d
(ns)
750
500
250
0
10
10^2
10^3
10^4
I_{GM} (mA)
gate pulse:
t_r <10 ns
t_p >10 μs
max
typ


7Z60900
300
200
100
0
t_q
(μs)
20
40
60
80
100
T_j (°C)
I_R = 2A
$\frac{dV}{dt}$ = 20V/μs
max. values
I_T =
300A
200A
100A
40A
10A

APPLICATION INFORMATION

Introduction

The behaviour of a magnetron in terms of stability, r.f. spectrum, frequency pulsing, etc. may be influenced considerably by the characteristics of the pulse modulator. Modulator and magnetron must be considered to be very closely interdependent.

For this reason, it is recommended that proposed designs for any particular magnetron-modulator combination should be discussed with the appropriate magnetron engineer.

Typical operating conditions of the magnetron YJ1200

	a	b	
Pulse duration	0.25	4	μs 1)
Pulse frequency	4000	400	Hz
Pulse voltage (Vp)	12		kV
Pulse current (Ip)	12		A
Duty factor (maximum value)	0.0025		
Rate of rise of voltage	80		kV/μs 2)
Output power (r.f. pulse)	50		kW

1. The current rating I_{TRM} (see page 3) of the BTX95series permits these operating conditions to be achieved using a pulse compression type modulator (see circuit on page 10). The thyristor current pulse is a half sine-wave having approximately a peak value

$$I_{TRM} = \pi \cdot I_p \cdot \frac{N_e}{N_t}$$

where I_p = magnetron pulse current

$$N_e = \frac{\text{magnetron pulse voltage } (V_P)}{\text{storage capacitor voltage } (V_{C1})}$$

$$N_t = \frac{\text{thyristor pulse duration}}{\text{magnetron pulse duration}}$$

Assume for the 4 μs application $N_t = 3$ and $N_e = 20$, giving $V_{C1} = 600$ V (i.e. thyristor off-state voltage). The resulting thyristor peak pulse current $I_{TRM} = 250$ A has a duration of 12 μs.

In practice, the current may be up to 20% higher due to magnetising current and core loss in transformer T1.

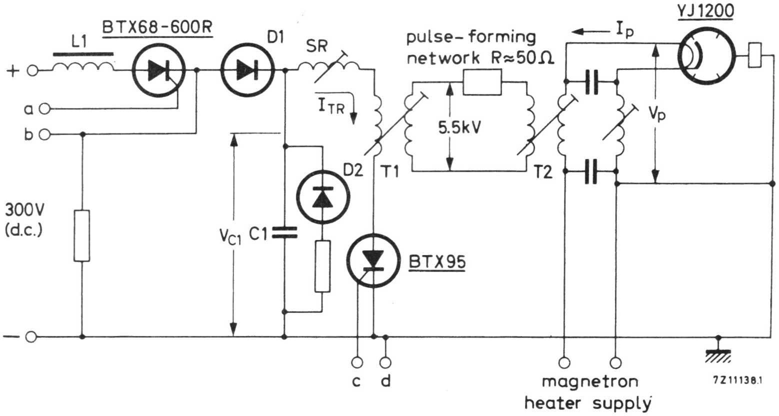
The values $N_t = 3$ and $\frac{dI_T}{dt} = 1000$ A/μs permit operation of the magnetron at pulse duration down to 0.3 μs; with higher values of N_t, shorter pulse durations are achieved.

---

1) Duration measured at 50% of current pulse amplitude.

2) Voltage rate of rise is the slope of the steepest tangent to the leading edge above 80% of the voltage pulse amplitude.

APPLICATION INFORMATION (continued)



L1 = charging inductor
D1 = hold-off diode
D2 = inverse diode
SR = 1 µs delay- and priming reactor
T1 = saturable-core charging transf. (n = 1 : 9)
T2 = saturable-core pulse transf. (n = 1 : 4.5) (bifilar secondary)
a;b = delayed-charging trigger
c;d = main trigger

2. Magnetrons of lower power rating may be driven by more conventional line type modulators (see circuit on page 12). A marine radar magnetron of 3 kW r.f. output power has the following typical operation conditions:

	a	b	
Pulse duration	0.05	0.5	µs (1)
Pulse frequency	2	1	kHz
Pulse voltage	3.8		kV
Pulse current	3		A
Duty factor (maximum value)	0.001		
Rate of rise of voltage	60		kV/µs (2)

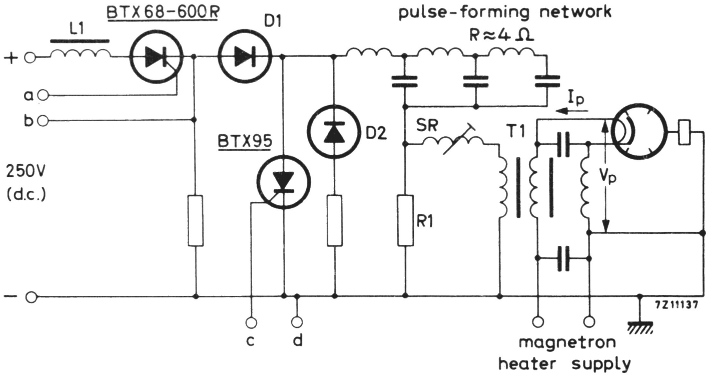
Those conditions are achieved in the circuit on page 12, with a pulse transformer ratio of 1 : 20 and a pulse forming network voltage of 450 V to 500 V. With correct adjustment of the pulse transformer distributed capacitance and leakage inductance, the load capacitance, the saturated inductance of reactor SR and the network parameters, the specified rate of rise of off-state voltage is achieved at the correct point on the leading edge, and the thyristor current pulse (65 A peak value) has a sinusoidal leading-edge of initial $\frac{dI_T}{dt} = 1000$ A/µs.

---

1) Duration measured at 50% of current pulse amplitude.

2) Voltage rate of rise is the slope of the steepest tangent to the leading edge above 80% of the voltage pulse amplitude.

APPLICATION INFORMATION (continued)


BTX68-600R
L1
D1
pulse-forming network
R≈4 Ω
+
a
b
250V
(d.c.)
BTX95
D2
SR
T1
Ip
Vp
R1
−
c
d
7Z11137
magnetron
heater supply

L1 = charging inductor
D1 = hold-off diode
D2 = inverse diode
SR = 0.25 to 0.5 μs delay reactor
R1 = priming current resistor (≈100 Ω)
T1 = linear pulse transformer
a; b = delayed-charging trigger
c; d = main trigger

P-GATE SILICON THYRISTORS

P-gate thyristors in a TO-64 metal envelope. They are intended for power control and power switching applications.
The series consists of reverse polarity types (anode to stud) BTY79-400R to BTY79-1000R.

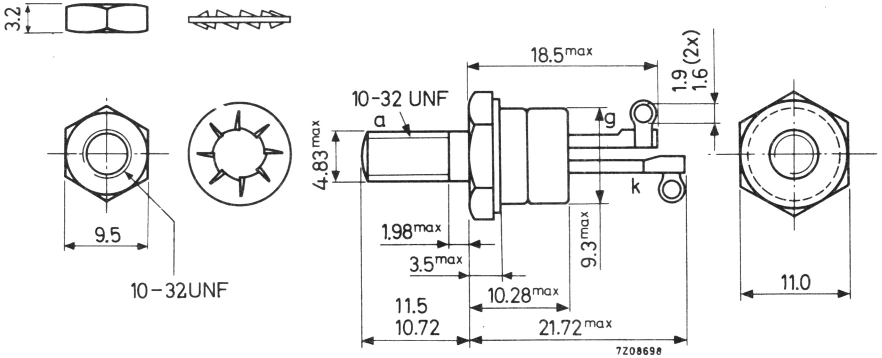
QUICK REFERENCE DATA

		BTY79-400R	500R	600R	800R	1000R	
Repetitive peak voltages $V_{DRM} = V_{RRM}$	max.	400	500	600	800	1000	V
Crest working voltages $V_{DWM} = V_{RWM}$	max.	400	500	600	800	1000	V
Forward breakover voltage $V_{(BO)}$	>	400	500	600	800	1000	V
Average on-state current at T_{mb} = 85 °C				$I_{T(AV)}$	max.	6.4	A
R.M.S. on-state current				$I_{T(RMS)}$	max.	10	A
Non-repetitive peak on-state current t = 10 ms; T_j = 125 °C prior to surge				I_{TSM}	max.	80	A
Junction temperature				T_j	max.	125	°C
Rate of rise of on-state current after triggering				$\frac{dI_T}{dt}$	max.	20	A/μs
Rate of rise of off-state voltage that will not trigger any device				$\frac{dV_D}{dt}$	<	20	V/μs

MECHANICAL DATA see page 2

MECHANICAL DATA
TO-64

Dimensions in mm



Net weight: 7.5 g
Diameter of clearance hole: max. 5.2 mm
Accessories supplied on request: 56295; (56262A)

Torque on nut: min. 8 kg cm
(0.8 Newton-metres)
max. 17 kg cm
(1.7 Newton-metres)

All information applies to frequencies up to 400 Hz.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

ANODE TO CATHODE

Voltages [1]		BTY79-400R	500R	600R	800R	1000R	
Non-repetitive peak off-state voltage ($t \leq 10$ ms) V_{DSM} [2]	max.	500	1100	1100	1100	1100	V
Non-repetitive peak reverse voltage ($t \leq 5$ ms) V_{RSM}	max.	500	600	720	960	1100	V
Repetitive peak voltages $V_{DRM} = V_{RRM}$	max.	400	500	600	800	1000	V
Crest working voltages $V_{DWM} = V_{RWM}$	max.	400	500	600	800	1000	V
Continuous voltages $V_D = V_R$	max.	400	500	600	800	1000	V

---

[1] To ensure thermal stability: $R_{th\ j-a} < 6\,^{\circ}C/W$ (d.c. blocking) or $< 12\,^{\circ}C/W$ (a.c.)

[2] Higher off-state voltages may be applied without damage, but at voltages higher than the minimum forward breakover voltage (see page 4) the thyristor may switch into the on-state. The rate of rise of on-state current should not exceed 100 A/μs.

RATINGS (continued)

Currents

Average on-state current (averaged over any 20 ms period) at T_{mb} = 85 °C	$I_{T(AV)}$	max.	6.4	A
On-state current (d.c.)	I_T	max.	10	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	10	A
Repetitive peak on-state current	I_{TRM}	max.	60	A
Non-repetitive peak on-state current (t = 10 ms; half sine wave) T_j = 125 °C prior to surge	I_{TSM}	max.	80	A
I^2t for fusing (t = 10 ms)	I^2t	max.	32	A^2s
Rate of rise of on-state current after triggering with $I_G = I_{GT}$ to $I_T = 3 \times I_{T(AV)}$	$\frac{dI_T}{dt}$	max.	20	A/µs
Repetitive peak reverse current (during turn-off)	I_{RRM}	max.	5	A

GATE TO CATHODE

Voltages

Forward peak voltage	V_{FGM}	max.	10	V
Reverse peak voltage	V_{RGM}	max.	5	V

Power dissipation

Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	0.5	W
Peak power dissipation	P_{GM}	max.	5	W

Temperatures

Storage temperature	T_{stg}	−55 to	+125	°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	3.0 °C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.5 °C/W
From mounting base to heatsink with mica washer	$R_{th\ mb\text{-}h}$	=	4.0 °C/W
Transient thermal impedance (t = 1 ms)	$Z_{th\ j\text{-}mb}$	=	0.16 °C/W

CHARACTERISTICS

ANODE TO CATHODE

Voltages		BTY79-400R	500R	600R	800R	1000R	
On-state voltage I_T = 20 A; T_j = 25 °C	V_T	< 2.3	2.3	2.3	2.3	2.3	V
Forward breakover voltage up to T_j = 125 °C	$V_{(BO)}$	> 400	500	600	800	1000	V
Rate of rise of off-state voltage that will not trigger any device; T_j = 125 °C	$\frac{dV_D}{dt}$	< 100	100	100	100	100	V/µs
Currents							
Peak reverse current $V_{RM} = V_{RWMmax}$; T_j = 125 °C	I_{RM}	< 5	2.5	2.5	2.5	2.5	mA
Peak off-state current $V_{DM} = V_{DWMmax}$; T_j = 125 °C	I_{DM}	< 5	2.5	2.5	2.5	2.5	mA

Holding current; T_j = 25 °C	I_H	typ.	10 mA

GATE TO CATHODE

Voltages			
Voltage that will trigger all devices V_D = 6 V; T_j = 25 °C	V_{GT}	>	2.5 V
Voltage that will not trigger any device $V_D = V_{DWMmax}$; T_j = 125 °C	V_{GD}	<	250 mV
Current			
Current that will trigger all devices V_D = 6 V; T_j = 25 °C	I_{GT}	>	25 mA

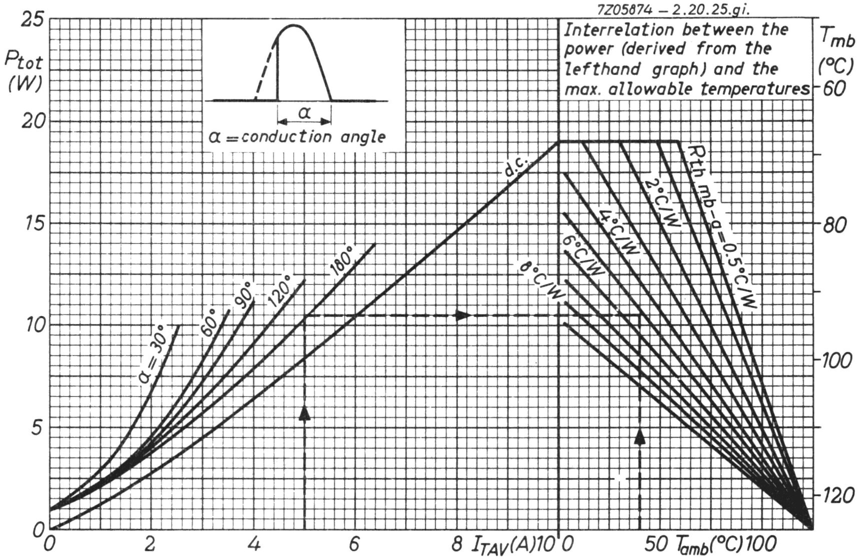
CHARACTERISTICS (continued)

SWITCHING CHARACTERISTICS

Turn-on time ($t_{on} = t_d + t_r$) **w**hen switched from V_D = 50 V to I_T = 10 A I_{GT} = 150 mA; T_j = 25 °C	t_{on}	typ.	3	µs
Circuit-commutated turn-off time when switched from I_T = 5 A to $V_R \geq$ 50 V with $-dI_T/dt$ = 5 A/µs; dV_D/dt = 10 V/µs				
T_j = 125 °C	t_q	<	100	µs
T_j = 25 °C	t_q	<	50	µs

OPERATING NOTES

1. The gate and cathode connectors should not be bent; they should be soldered into the circuit so that there is no strain on them.



EXAMPLE (Determination of the heatsink thermal resistance)

Assume the thyristor used in a 50 Hz single phase full wave rectifier circuit (conduction angle $\alpha = 180^\circ$) at $T_{amb} = 40\ ^\circ C$.
The average forward current (per thyristor) $I_{TAV} = 5$ A.

From the left hand part of the graph above it follows that at $I_{TAV} = 5$ A and $\alpha = 180^\circ$ the average forward power + average leakage power = 10.5 W per thyristor.

From the right hand part follows the thermal resistance, required for $P_{tot} = 10.5$ W at $T_{amb} = 40\ ^\circ C$.

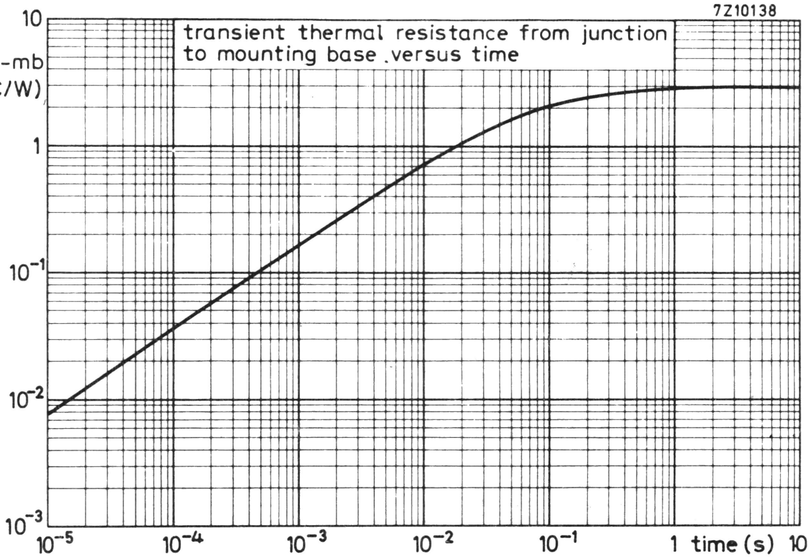
$$R_{th\ mb-a} \approx 5.2\ ^\circ C/W$$

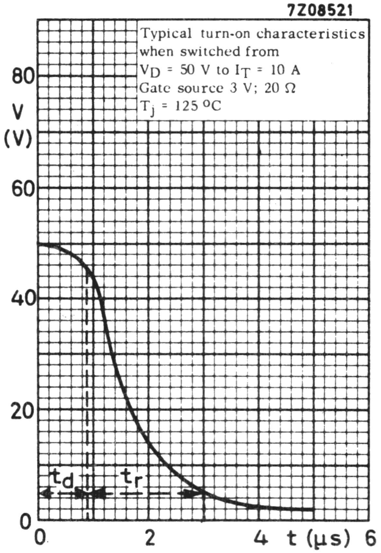
The contact thermal resistance $R_{th\ mb-h} = 0.5\ ^\circ C/W$

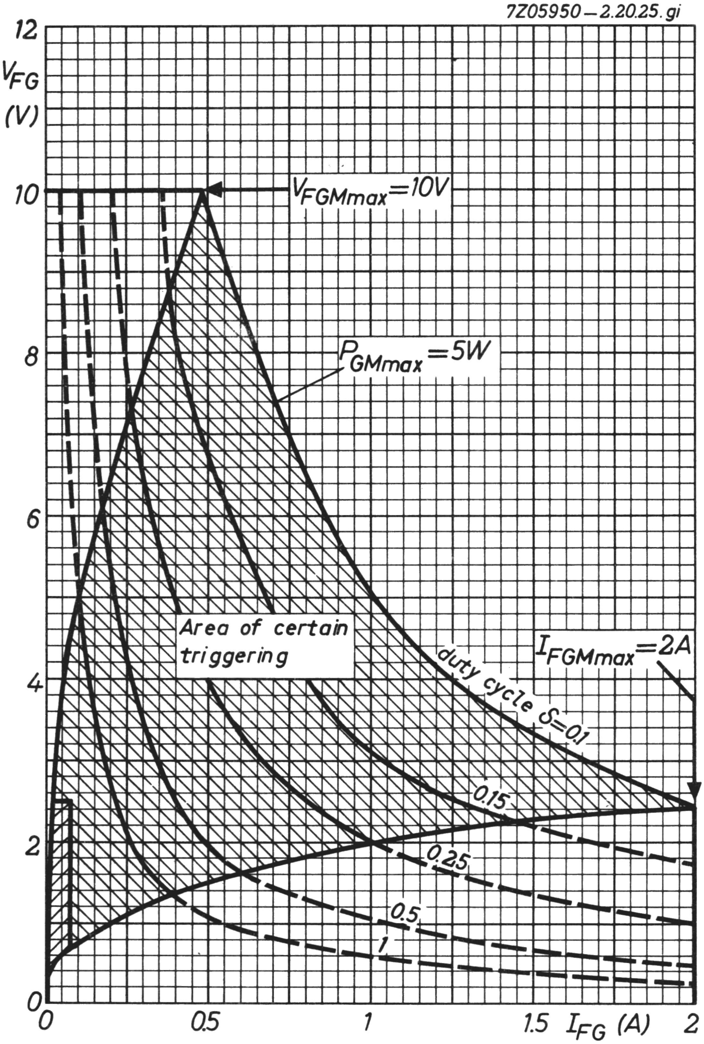
Hence the heatsink thermal resistance should be:

$$R_{th\ h-a} = R_{th\ mb-a} - R_{th\ mb-h} = (5.2 - 0.5)\ ^\circ C/W = 4.7\ ^\circ C/W$$

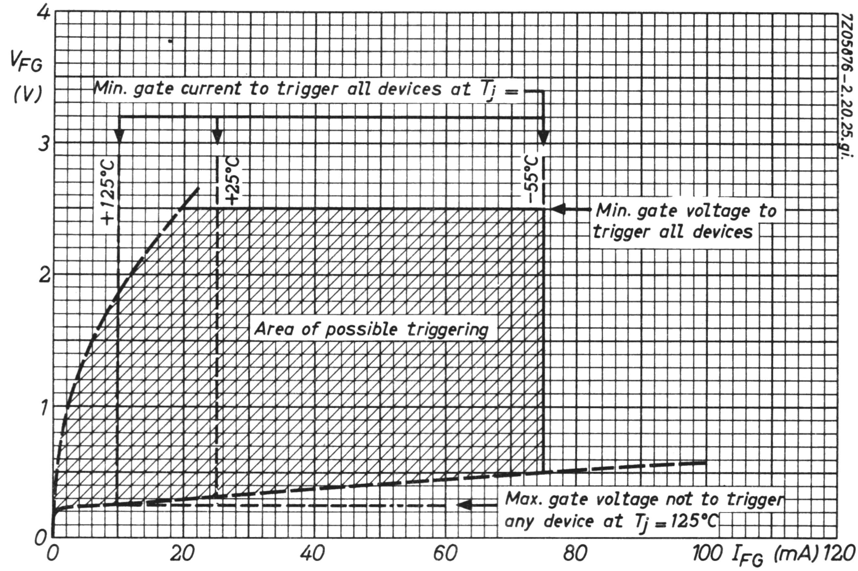
The applicable heatsink(s) may then be found in the section HEATSINKS.

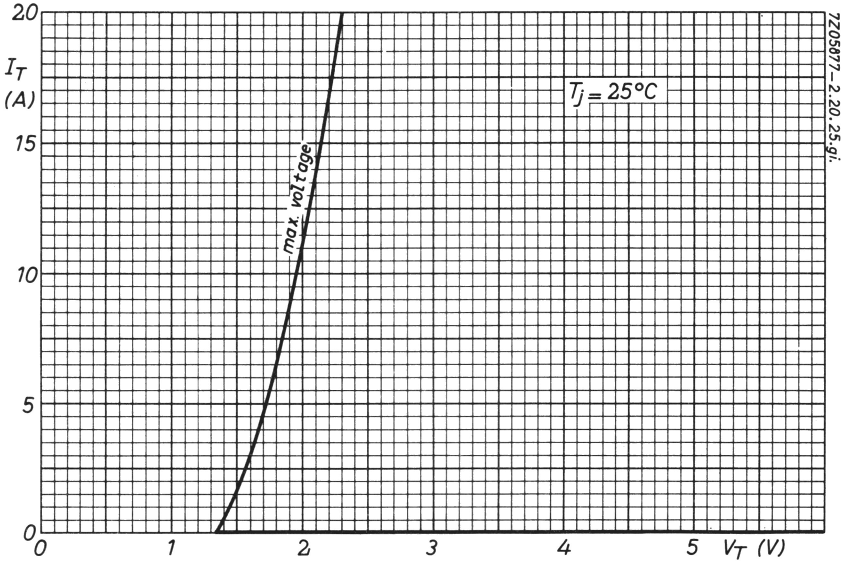

7Z10138
transient thermal resistance from junction to mounting base versus time
$Z_{th\ j\text{-}mb}$ (°C/W)
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
time (s)
10

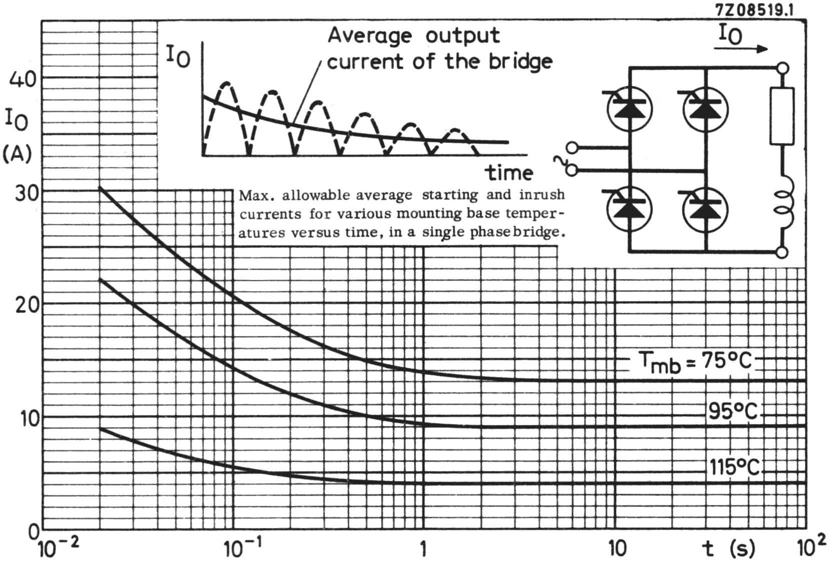

7Z08521
Typical turn-on characteristics when switched from
V_D = 50 V to I_T = 10 A
Gate source 3 V; 20 Ω
T_j = 125 °C
V (V)
80
60
40
20
0
t_d
t_r
0
2
4
t (μs)
6



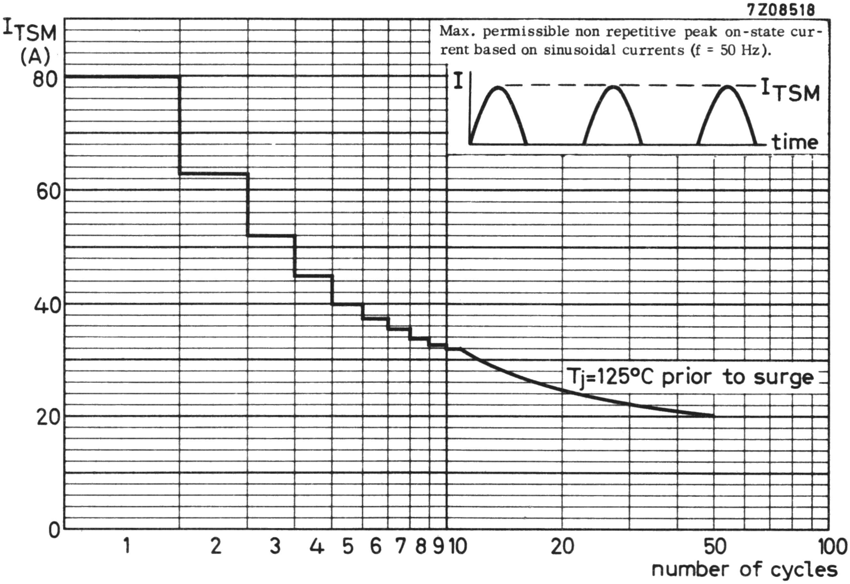
Gate characteristics with curves P_{GAV}=0.5W


7Z05876-2.20.25.gi.
V_{FG} (V)
4
3
2
1
0
Min. gate current to trigger all devices at T_j =
+125°C
+25°C
−55°C
Min. gate voltage to trigger all devices
Area of possible triggering
Max. gate voltage not to trigger any device at T_j = 125°C
0
20
40
60
80
100
I_{FG} (mA)
120


7Z05877-2.20.25.gi.
I_T (A)
20
15
10
5
0
T_j = 25°C
max. voltage
0
1
2
3
4
5
V_T (V)



Max. allowable average starting and inrush currents for various mounting base temperatures versus time, in a single phase bridge.



Max. permissible non repetitive peak on-state current based on sinusoidal currents (f = 50 Hz).

P-GATE SILICON THYRISTORS

P-gate thyristors in a TO-48 metal envelope. They are intended for power control and power switching applications.
The series consists of the reverse polarity types (anode to stud) BTY87-400R to 800R.

QUICK REFERENCE DATA

		BTY87-400R	500R	600R	800R	
Repetitive peak voltages $V_{DRM} = V_{RRM}$	max.	400	500	600	800	V
Crest working voltages $V_{DWM} = V_{RWM}$	max.	400	500	600	800	V
Forward breakover voltage $V_{(BO)}$	>	400	500	600	800	V

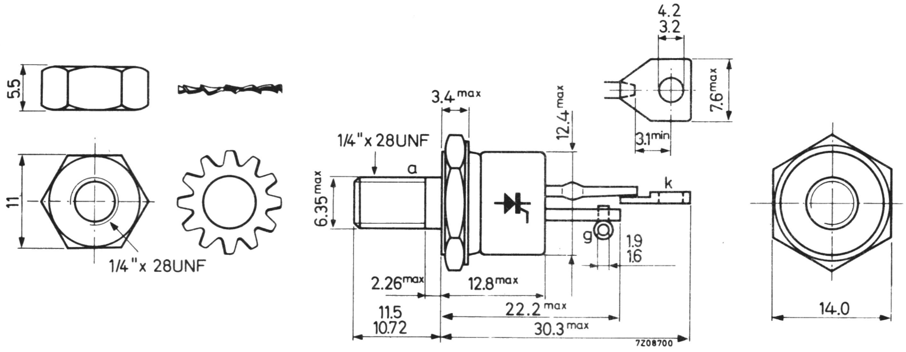
Average on-state current up to T_{mb} = 52 °C	$I_{T(AV)}$	max.	16	A
at T_{mb} = 85 °C	$I_{T(AV)}$	max.	10	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	25	A
Non-repetitive peak on-state current t = 10 ms; T_j = 125 °C prior to surge	I_{TSM}	max.	140	A
Junction temperature	T_j	max.	125	°C
Rate of rise of on-state current after triggering	$\frac{dI_T}{dt}$	max.	20	A/µs
Rate of rise of off-state voltage that will not trigger any device	$\frac{dV_D}{dt}$	<	20	V/µs

MECHANICAL DATA see page 2

MECHANICAL DATA

Dimensions in mm

TO-48


5.5
11
1/4"x 28UNF
1/4"x 28UNF
a
6.35 max
3.4 max
12.4 max
4.2
3.2
7.6 max
3.1 min
k
g
1.9
1.6
2.26 max
12.8 max
11.5
10.72
22.2 max
30.3 max
7Z08700
14.0

Torque on nut: min. 17 kg cm
(1.7 Newton-metres)
max. 35 kg cm
(3.5 Newton-metres)

Net weight: 15 g
Diameter of clearance hole: max. 6.5 mm
Accessories supplied on request: 56264A

All information applies to frequencies up to 400 Hz.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

ANODE TO CATHODE

Voltages [1]		BTY87-400R	500R	600R	800R	
Non-repetitive peak off-state voltage ($t \leq 10$ ms) V_{DSM} [2]	max.	500	850	850	850	V
Non-repetitive peak reverse voltage ($t \leq 5$ ms) V_{RSM}	max.	500	600	850	960	V
Repetitive peak voltages $V_{DRM} = V_{RRM}$	max.	400	500	600	800	V
Crest working voltages $V_{DWM} = V_{RWM}$	max.	400	500	600	800	V
Continuous voltages $V_D = V_R$	max.	400	500	600	800	V

---

[1] To ensure thermal stability: $R_{th\ j\text{-}a} < 4.5\ ^{\circ}C/W$ (d.c. blocking) or $< 9\ ^{\circ}C/W$ (a.c.). For smaller heatsinks $T_{j\ max}$ should be derated.

[2] Higher off-state voltages may be applied without damage, but at voltages higher than the minimum forward breakover voltage (see page 4) the thyristor may switch into the on-state.

RATINGS (continued)

Currents

Average on-state current (averaged over any 20 ms period) up to $T_{mb} = 52\ ^{o}C$	$I_{T(AV)}$	max.	16	A	←
at $T_{mb} = 85\ ^{o}C$	$I_{T(AV)}$	max.	10	A	
On-state current (d.c.)	I_T	max.	19	A	
R.M.S. on-state current	$I_{T(RMS)}$	max.	25	A	
Repetitive peak on-state current	I_{TRM}	max.	140	A	
Non-repetitive peak on-state current (t = 10 ms; half sine wave) $T_j = 125\ ^{o}C$ prior to surge	I_{TSM}	max.	140	A	
I^2t for fusing (t = 10 ms)	I^2t	max.	100	A^2s	
Rate of rise of on-state current after triggering with $I_G = I_{GT}$ to $I_T = 3 \times I_{T(AV)}$	$\frac{dI_T}{dt}$	max.	20	A/µs	
Repetitive peak reverse current (during turn-off)	I_{RRM}	max.	20	A	

GATE TO CATHODE

Voltage

Forward peak voltage	V_{FGM}	max.	10	V
Reverse peak voltage	V_{RGM}	max.	5	V

Power dissipation

Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	0.5	W
Peak power dissipation	P_{GM}	max.	5	W

Temperatures

Storage temperature	T_{stg}	-55 to +125		^{o}C
Junction temperature	T_j	max.	125	^{o}C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j-mb}$	=	1.6	°C/W
From mounting base to heatsink	$R_{th\ mb-h}$	=	0.2	°C/W
From mounting base to heatsink with mica washer	$R_{th\ mb-h}$	=	4.0	°C/W
Transient thermal impedance (t = 1 ms)	$Z_{th\ j-mb}$	=	0.09	°C/W

CHARACTERISTICS

ANODE TO CATHODE

Voltages			BTY87-400R	500R	600R	800R	
On-state voltage I_T = 50 A; T_j = 25 °C	V_T	<	3.0	3.0	3.0	3.0	V
Forward breakover voltage up to T_j = 125 °C	$V_{(BO)}$	>	400	500	600	800	V
Rate of rise of off-state voltage that will not trigger any device; T_j = 125 °C	$\frac{dV_D}{dt}$	<	20	20	20	20	V/µs
Currents							
Peak reverse current $V_{RM} = V_{RWMmax}$; T_j = 125 °C	I_{RM}	<	8.0	6.0	5.0	4.0	mA
Peak off-state current $V_{DM} = V_{DWMmax}$; T_j = 125 °C	I_{DM}	<	8.0	6.0	5.0	4.0	mA

Latching current; T_j = 25 °C	I_L	typ.	20	mA
Holding current; T_j = 25 °C	I_H	typ.	10	mA

GATE TO CATHODE

Voltages				
Voltage that will trigger all devices V_D = 6 V; T_j = 25 °C	V_{GT}	>	3.5	V
Voltage that will not trigger any device $V_D = V_{DWMmax}$; T_j = 125 °C	V_{GD}	<	200	mV
Current				
Current that will trigger all devices V_D = 6 V; T_j = 25 °C	I_{GT}	>	65	mA

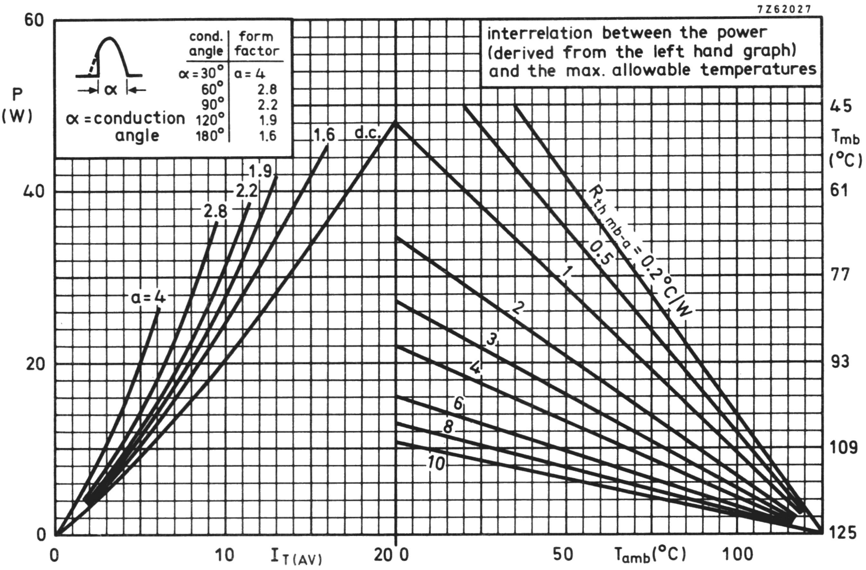
CHARACTERISTICS (continued)

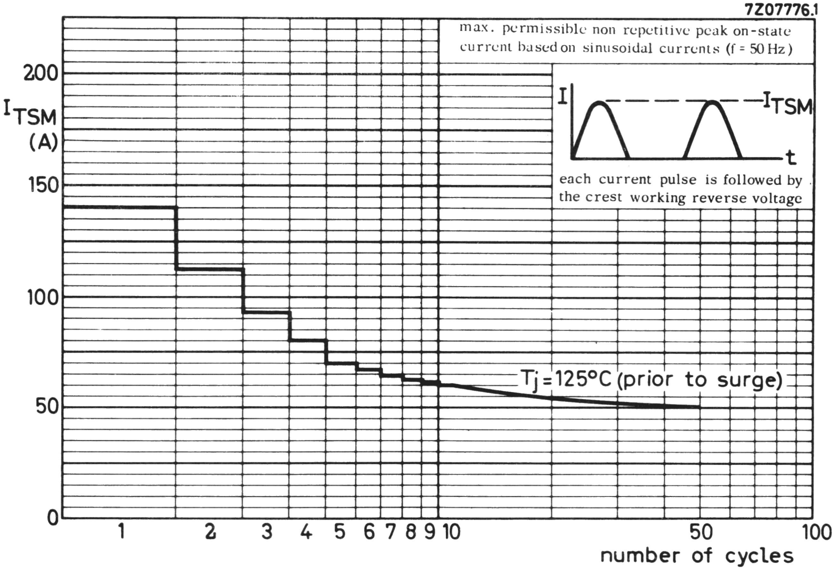
SWITCHING CHARACTERISTICS

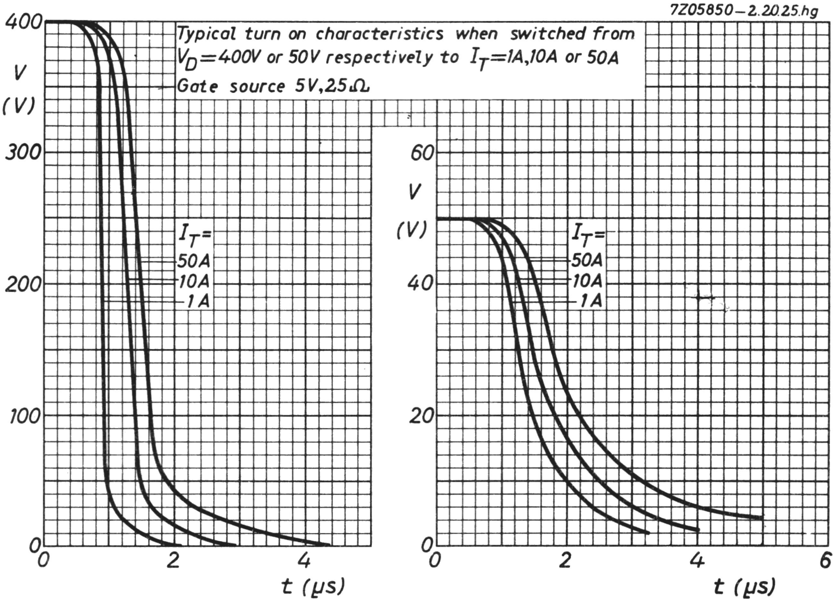
Turn-on time ($t_{on} = t_d + t_r$) when switched from V_D = 400 V to I_T = 50 A I_{GT} = 200 mA; T_j = 25 °C	t_{on}	typ.	2	µs
Circuit-commutated turn-off time when switched from I_T = 10 A to $V_R \geq$ 50 V with $-dI_T/dt$ = 10 A/µs; dV_D/dt = 10 V/µs T_j = 125 °C	t_q	<	100	µs
T_j = 25 °C	t_q	<	50	µs

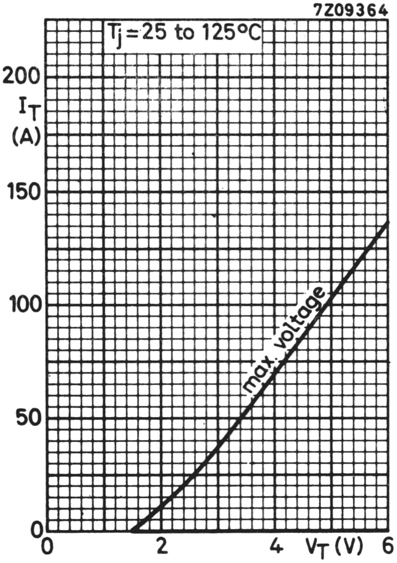
OPERATING NOTES (See also general pages at the beginning of this section)

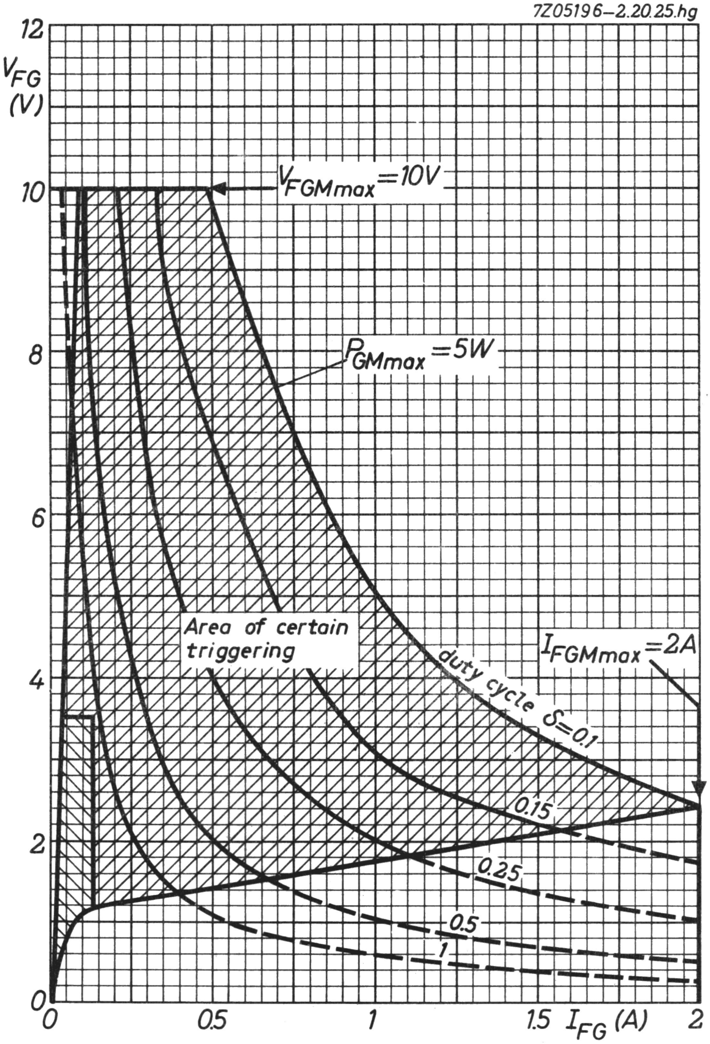
1. The gate and cathode connectors should not be bent; they should be soldered into the circuit so that there is no strain on them.


7Z62027
60
40
20
0
P
(W)
cond. angle
form factor
α = 30°
a = 4
60°
2.8
90°
2.2
120°
1.9
180°
1.6
α
α = conduction angle
a = 4
2.8
2.2
1.9
1.6
d.c.
0
10
$I_{T(AV)}$
20
0
50
T_{amb}(°C)
100
interrelation between the power (derived from the left hand graph) and the max. allowable temperatures
$R_{th\ mb-a}$ = 0.2°C/W
0.5
1
2
3
4
6
8
10
45
T_{mb}
(°C)
61
77
93
109
125

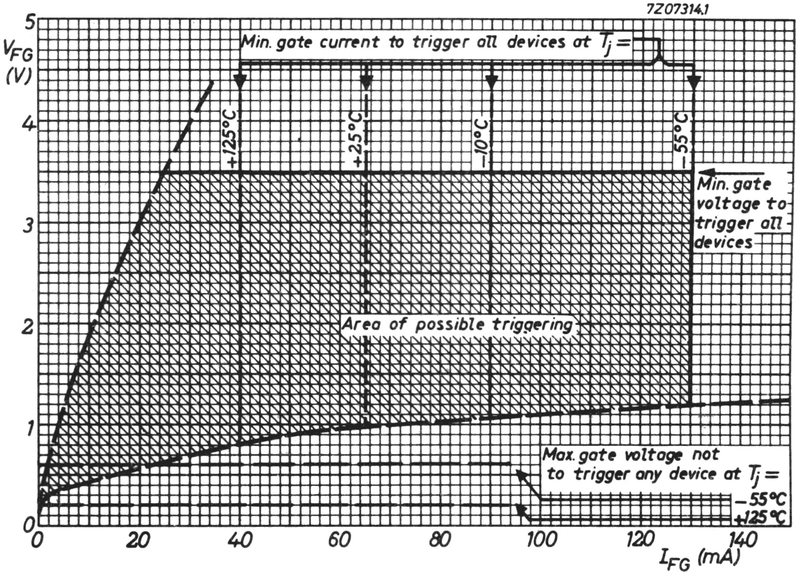

7Z07776.1
max. permissible non repetitive peak on-state current based on sinusoidal currents (f = 50 Hz)
200
I_{TSM}
(A)
150
100
50
0
I
I_{TSM}
t
each current pulse is followed by the crest working reverse voltage
T_j = 125°C (prior to surge)
1
2
3
4
5
6
7
8
9
10
50
100
number of cycles

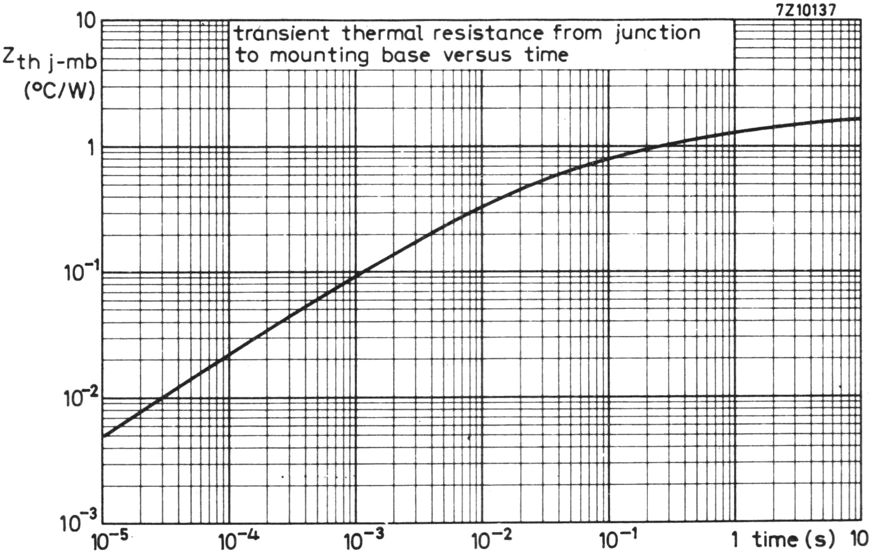

7Z05850—2.20.25.hg
Typical turn on characteristics when switched from
V_D=400V or 50V respectively to I_T=1A,10A or 50A
Gate source 5V,25Ω
400
V
(V)
300
200
100
0
0
2
4
t (μs)
I_T=
50A
10A
1A
60
V
(V)
40
20
0
0
2
4
6
t (μs)
I_T=
50A
10A
1A


7Z09364
T_j=25 to 125°C
200
I_T
(A)
150
100
50
0
0
2
4
V_T (V)
6
max. voltage

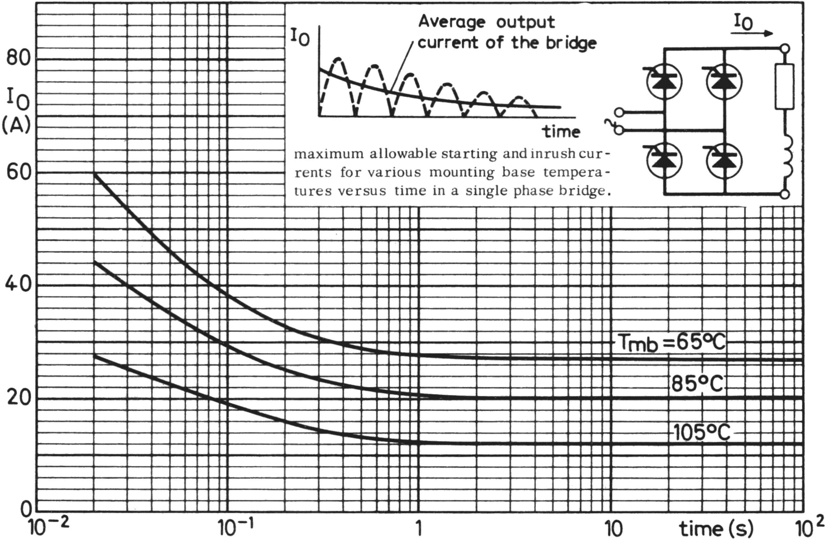


Gate characteristics with curves P_{GAV}=0.5W


7Z07314.1
V_{FG} (V)
0
1
2
3
4
5
Min. gate current to trigger all devices at T_j =
+125°C
+25°C
−10°C
−55°C
Min. gate voltage to trigger all devices
Area of possible triggering
Max. gate voltage not to trigger any device at T_j =
−55°C
+125°C
0
20
40
60
80
100
120
140
I_{FG} (mA)

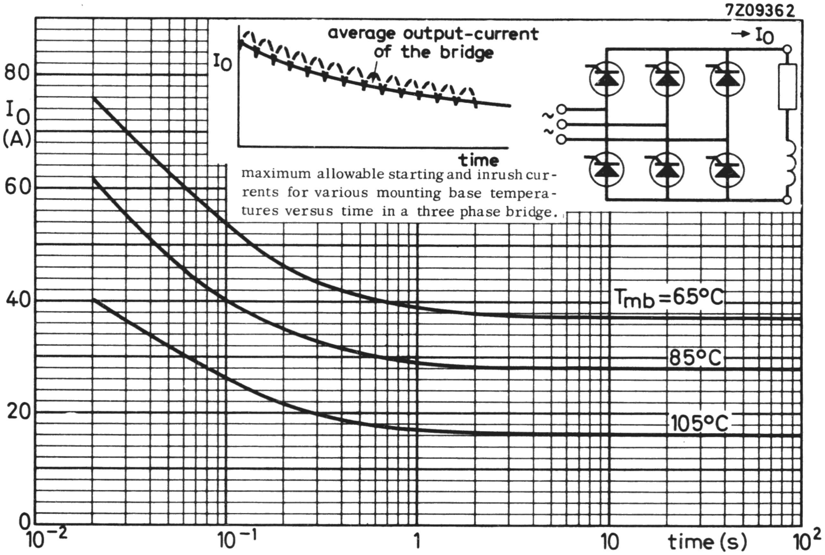

7Z10137
10
$Z_{th\ j\text{-}mb}$ (°C/W)
1
10^{-1}
10^{-2}
10^{-3}
transient thermal resistance from junction to mounting base versus time
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
time (s)
10

7Z09361



maximum allowable starting and inrush currents for various mounting base temperatures versus time in a single phase bridge.

7Z09362



maximum allowable starting and inrush currents for various mounting base temperatures versus time in a three phase bridge.

P-GATE SILICON THYRISTORS

P-gate thyristors in a TO-48 metal envelope. They are intended for power control and power switching applications.
The series consists of the reverse polarity types (anode to stud) BTY91-400R to 800R.

QUICK REFERENCE DATA

		BTY91-400R	500R	600R	800R
Repetitive peak voltages $V_{DRM} = V_{RRM}$	max.	400	500	600	800 V
Crest working voltages $V_{DWM} = V_{RWM}$	max.	400	500	600	800 V
Forward breakover voltage $V_{(BO)}$	>	400	500	600	800 V

Average on-state current up to T_{mb} = 77 °C	$I_{T(AV)}$	max.	16	A
at T_{mb} = 85 °C	$I_{T(AV)}$	max.	14	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	25	A
Non-repetitive peak on-state current t = 10 ms; T_j = 125 °C prior to surge	I_{TSM}	max.	200	A
Junction temperature	T_j	max.	125	°C
Rate of rise of on-state current after triggering	$\frac{dI_T}{dt}$	max.	20	A/µs
Rate of rise of off-state voltage that will not trigger any device	$\frac{dV_D}{dt}$	<	20	V/µs

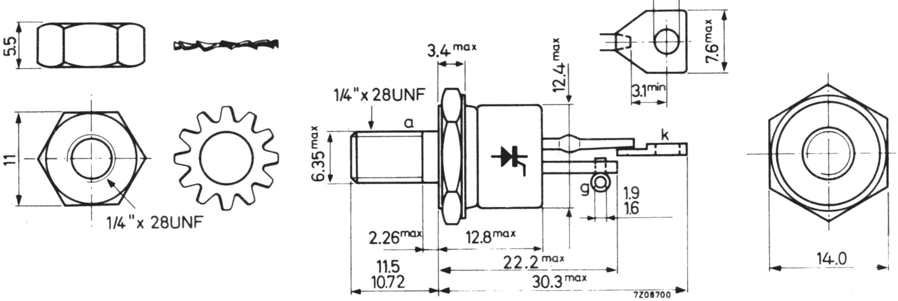
MECHANICAL DATA see page 2

MECHANICAL DATA

TO-48

4.2
3.2

Dimensions in mm


5.5
11
1/4"x 28UNF
3.4 max
1/4"x 28UNF
a
12.4 max
3.1 min
7.6 max
k
6.35 max
g
1.9
1.6
2.26 max
12.8 max
11.5
10.72
22.2 max
30.3 max
14.0
7Z08700

Torque on nut: min. 17 kg cm
(1.7 Newton-metres)
max. 35 kg cm
(3.5 Newton-metres)

Net weight: 15 g
Diameter of clearance hole: max. 6.5 mm
Accessories supplied on request: 56264A

All information applies to frequencies up to 400 Hz.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

ANODF TO CATHODE

Voltages (1)		BTY91-400R	500R	600R	800R
Non-repetitive peak off-state voltage ($t \leq$ 10 ms) V_{DSM} (2)	max.	500	850	850	850 V
Non-repetitive peak reverse voltage ($t <$ 5 ms) V_{RSM}	max.	500	600	720	960 V
Repetitive peak voltages $V_{DRM} = V_{RRM}$	max.	400	500	600	800 V
Crest working voltages $V_{DWM} = V_{RWM}$	max.	400	500	600	800 V
Continuous voltages $V_D = V_R$	max.	400	500	600	800 V

---

1) To ensure thermal stability: $R_{th\ j-a} <$ 4.5 °C/W (d.c. blocking) or $<$ 9 °C/W (a.c.). For smaller heatsinks $T_{j\ max}$ should be derated.

2) Higher off-state voltages may be applied without damage, but at voltages higher than the minimum forward breakover voltage (see page 4) the thyristor may switch into the on-state.

RATINGS (continued)

Currents

Average on-state current (averaged over any 20 ms period) up to $T_{mb} = 77\,^{o}C$	$I_{T(AV)}$	max.	16	A
at $T_{mb} = 85\,^{o}C$	$I_{T(AV)}$	max.	14	A
On-state current (d.c.)	I_T	max.	25	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	25	A
Repetitive peak on-state current	I_{TRM}	max.	200	A
Non-repetitive peak on-state current (t = 10 ms; half sine wave) $T_j = 125\,^{o}C$ prior to surge	I_{TSM}	max.	200	A
I^2t for fusing (t = 10 ms)	I^2t	max.	200	A^2s
Rate of rise of on-state current after triggering with $I_G = I_{GT}$ to $I_T = 3 \times I_{T(AV)}$	$\frac{dI_T}{dt}$	max.	20	A/µs
Repetitive peak reverse current (during turn-off)	I_{RRM}	max.	20	A

GATE TO CATHODE

Voltages

Forward peak voltage	V_{FGM}	max.	10	V
Reverse peak voltage	V_{RGM}	max.	5	V

Power dissipation

Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	0.5	W
Peak power dissipation	P_{GM}	max.	5	W

Temperatures

Storage temperature	T_{stg}	−55 to +125		^{o}C
Junction temperature	T_j	max.	125	^{o}C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.6	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.2	°C/W
From mounting base to heatsink with mica washer	$R_{th\ mb\text{-}h}$	=	4.0	°C/W
Transient thermal impedance (t = 1 ms)	$Z_{th\ j\text{-}mb}$	=	0.09	°C/W

CHARACTERISTICS

ANODE TO CATHODE

			BTY91-400R	500R	600R	800R
Voltages						
On-state voltage I_T = 50 A; T_j = 25 °C	V_T	<	2.0	2.0	2.0	2.0 V
Forward breakover voltage up to T_j = 125 °C	$V_{(BO)}$	>	400	500	600	800 V
Rate of rise of off-state voltage that will not trigger any device; T_j = 125 °C	$\frac{dV_D}{dt}$	<	20	20	20	20 V/µs
Currents						
Peak reverse current $V_{RM} = V_{RWMmax}$; T_j = 125 °C	I_{RM}	<	8.0	6.0	5.0	4.0 mA
Peak off-state current $V_{DM} = V_{DWMmax}$; T_j = 125 °C	I_{DM}	<	8.0	6.0	5.0	4.0 mA

Latching current; T_j = 25 °C	I_L	<	20 mA
Holding current; T_j = 25 °C	I_H	<	10 mA

GATE TO CATHODE

Voltages

Voltage that will trigger all devices V_D = 6 V; T_j = 25 °C	V_{GT}	>	3.0 V
Voltage that will not trigger any device $V_D = V_{DWMmax}$; T_j = 125 °C	V_{GD}	<	200 mV

Current

Current that will trigger all devices V_D = 6 V; T_j = 25 °C	I_{GT}	>	40 mA

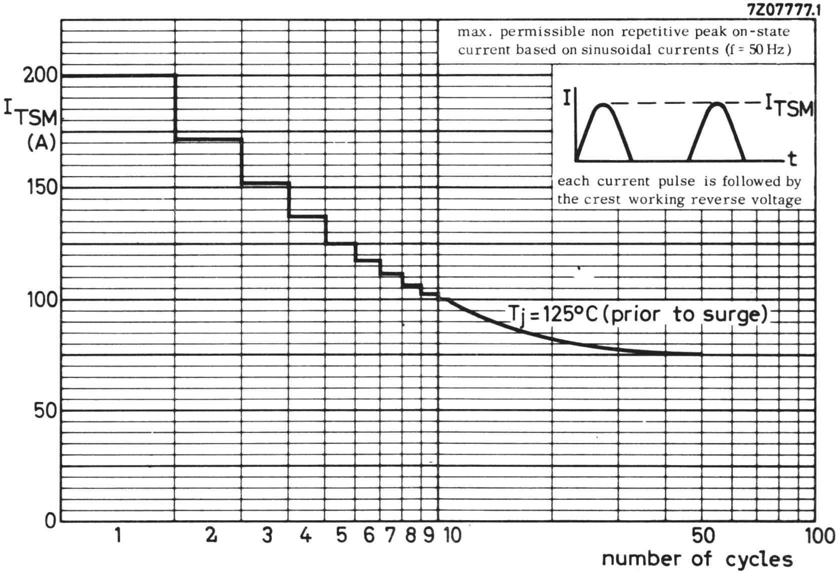
CHARACTERISTICS (continued)

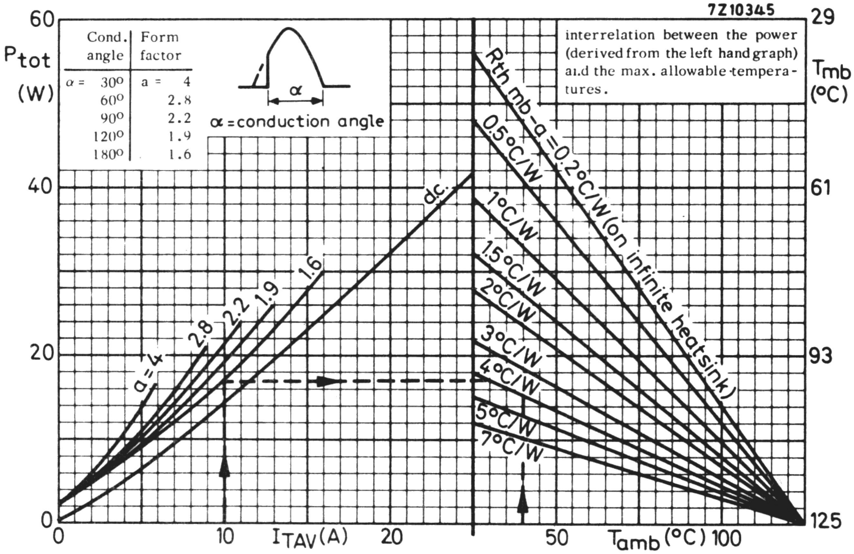
SWITCHING CHARACTERISTICS

Turn-on time ($t_{on} = t_d + t_r$) when switched from $V_D = 400$ V to $I_T = 10$ A $I_{GT} = 200$ mA; $T_j = 25\ ^oC$	t_{on}	typ.	2	μs
Circuit-commutated turn-off time when switched from $I_T = 10$ A to $V_R \geq 50$ V with $-dI_T/dt = 10$ A/μs; $dV_D/dt = 10$ V/μs				
$T_j = 125\ ^oC$	$-t_q$	<	100	μs
$T_j = 25\ ^oC$	$-t_q$	<	50	μs

OPERATING NOTES (See general pages at the beginning of this section)

1. The gate and cathode connectors should not be bent; they should be soldered into the circuit so that there is no strain on them





Determination of the heatsink thermal resistance

Example:
Assume a thyristor, used in a single phase full wave rectifier circuit.

conduction angle α = 180°
average forward current I_{TAV} = 10 A (per thyristor)
ambient temperature T_{amb} = 40 °C

From the left hand part of the graph above it follows that at I_{TAV} = 10 A and α = 180° the average forward power + average leakage power = 17 W per thyristor.

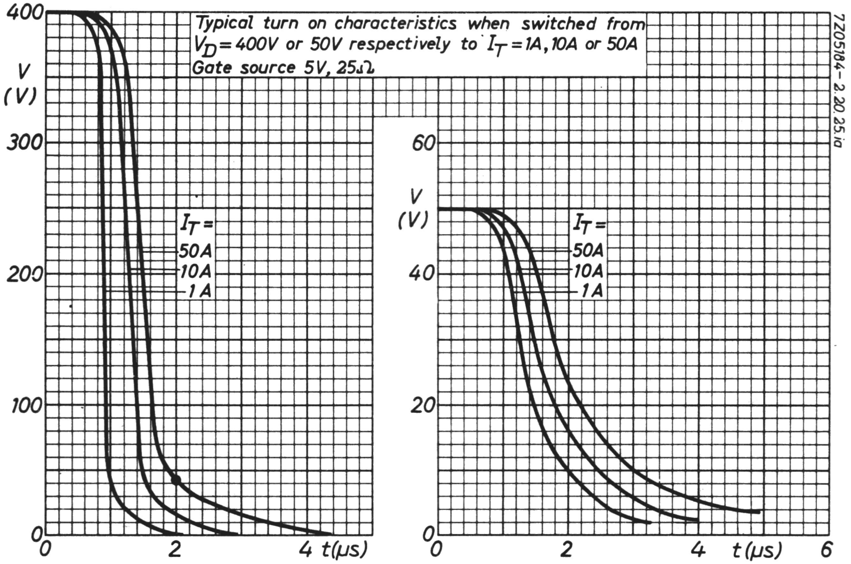
From the right hand part of the graph above follows the thermal resistance, required for P_{tot} = 17 W at T_{amb} = 40 °C

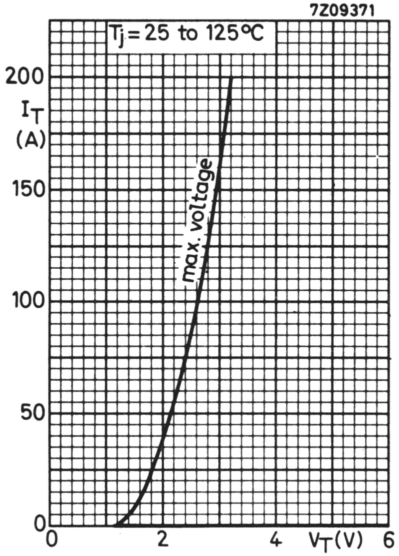
$$R_{th\ mb-a} \approx 3.5\ ^{\circ}C/W$$

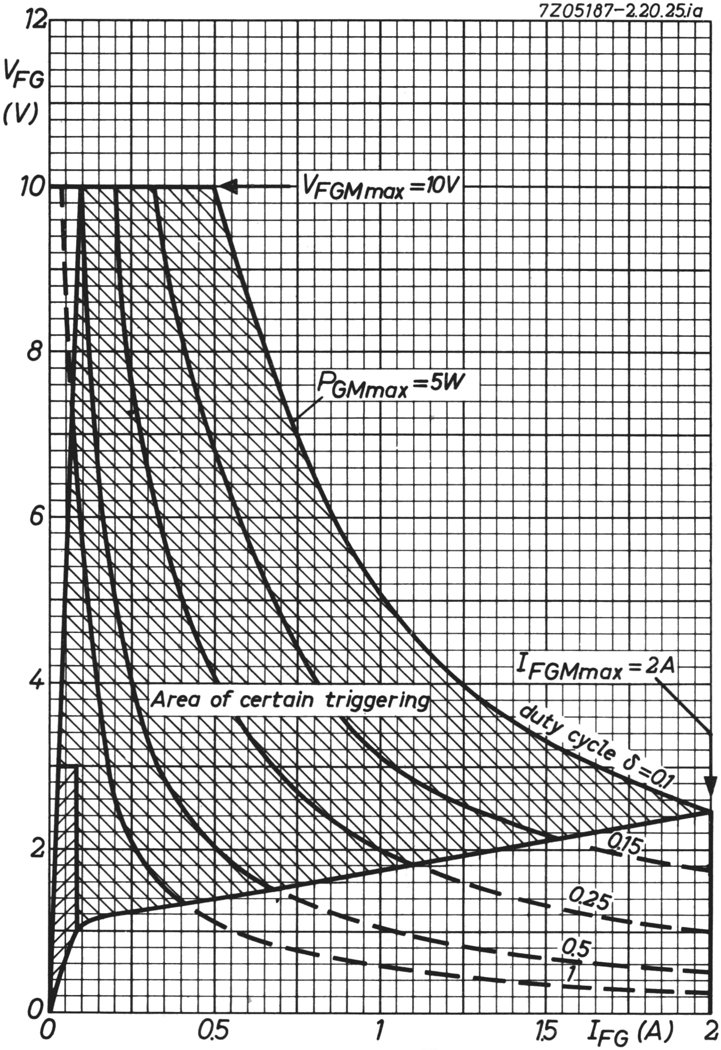
The contact thermal resistance $R_{th\ mb-h}$ = 0.2 °C/W.
Hence the heatsink thermal resistance should be:

$$R_{th\ h-a} = R_{th\ mb-a} - R_{th\ mb-h} = (3.5 - 0.2)\ ^{\circ}C/W = 3.3\ ^{\circ}C/W.$$

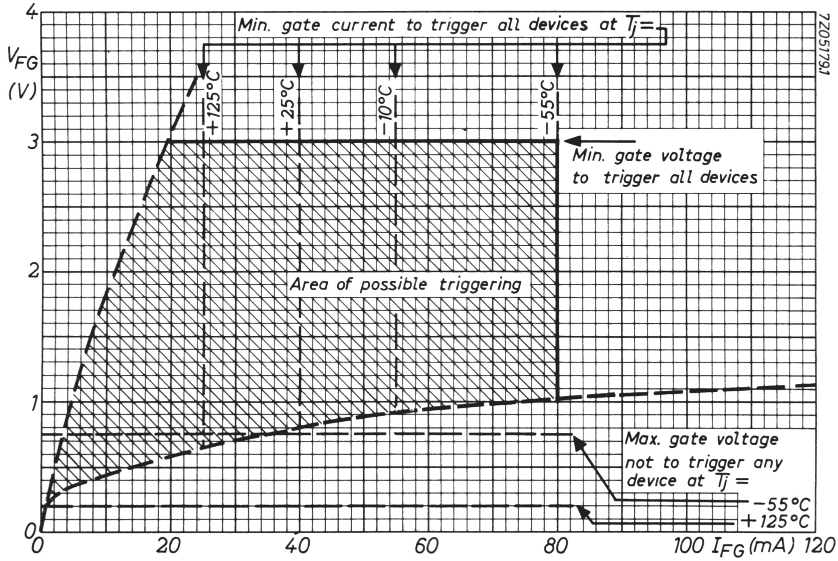
The appropriate heatsink(s) will be found in the Section HEATSINKS.

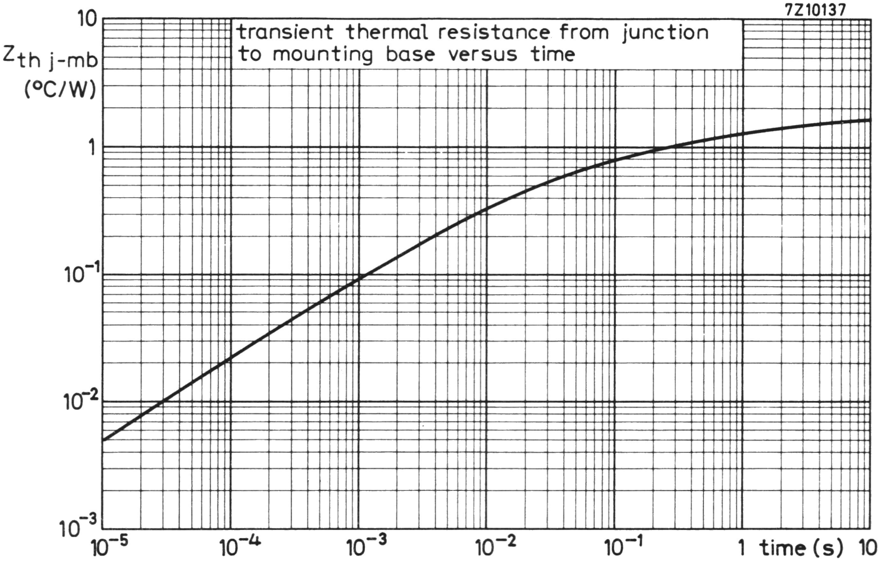

Typical turn on characteristics when switched from
V_D = 400V or 50V respectively to I_T = 1A, 10A or 50A
Gate source 5V, 25Ω
7Z05184-2.20.25.ia
400
300
200
100
0
V
(V)
I_T =
50A
10A
1A
0
2
4
t(μs)
60
40
20
0
V
(V)
I_T =
50A
10A
1A
0
2
4
t(μs)
6

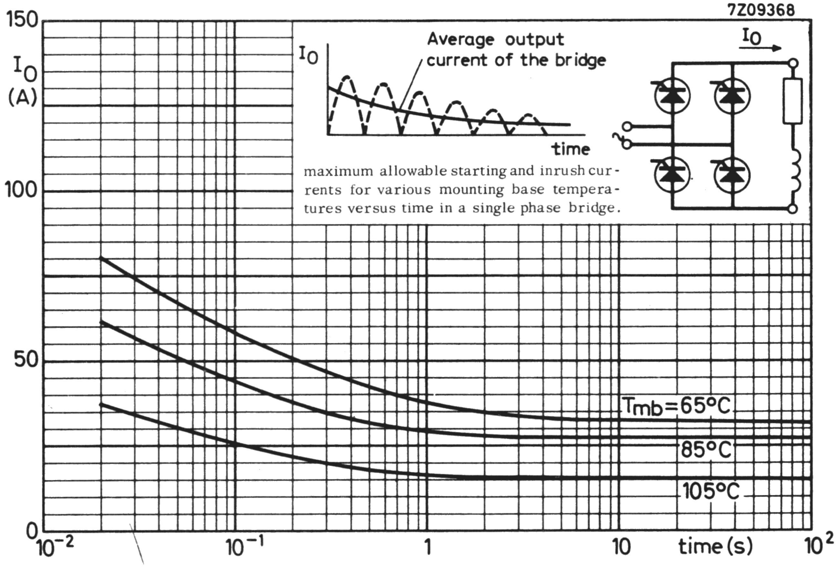

7Z09371
T_j = 25 to 125 °C
200
150
100
50
0
I_T
(A)
max. voltage
0
2
4
V_T(V)
6



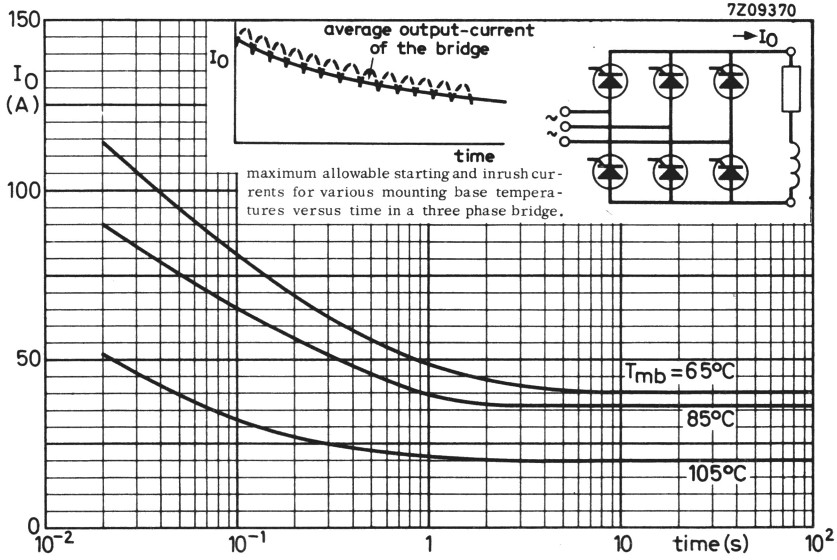
Gate characteristics with curves $P_{GAV}=0.5W$


7Z05179.1
V_{FG}
(V)
4
3
2
1
0
0
20
40
60
80
100 I_{FG} (mA) 120
Min. gate current to trigger all devices at T_j =
+125°C
+25°C
−10°C
−55°C
Min. gate voltage
to trigger all devices
Area of possible triggering
Max. gate voltage
not to trigger any
device at T_j =
−55°C
+125°C


7Z10137
transient thermal resistance from junction
to mounting base versus time
$Z_{th\ j\text{-}mb}$
(°C/W)
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
time (s)
10



maximum allowable starting and inrush currents for various mounting base temperatures versus time in a single phase bridge.



maximum allowable starting and inrush currents for various mounting base temperatures versus time in a three phase bridge.

P-GATE SILICON THYRISTORS

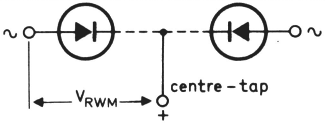
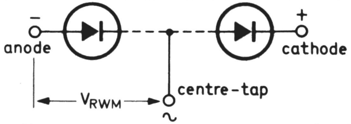
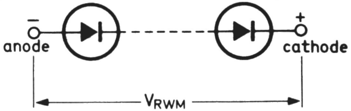
This type has been superseded by the BTW24series

P-GATE SILICON THYRISTORS

This type has been superseded by the BTW23series

Rectifier stacks

TYPE SELECTION CHART

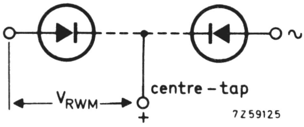
Type number		OSB9110	OSB9210	OSB9310	OSB9410	OSM9110	OSM9210	OSM9310	OSM9410	OSS9110	OSS9210	OSS9310	OSS9410
Number of diodes		4.6...28.30				4.6...28.30				3.4....29.30			
Circuit		 ∼ ∼ centre-tap V_{RWM} +				 − anode + cathode centre-tap V_{RWM} ∼				 − anode + cathode V_{RWM}			
Crest working reverse voltage		2.3...14.15 kV				2.3...14.15 kV				3.4....29.30 kV			
	T_{amb} = 35 °C	3.5 A	5 A	4 A	10 A	3.5 A	5 A	4 A	10 A	3.5 A	5 A	4 A	10 A
Average forward current per diode at:	T_{oil} = 30 °C		20 A				20 A				20 A		
	T_{oil} = 35 °C				30 A				30 A				30 A
	T_{oil} = 65 °C			12 A				12 A				12 A	
	T_{oil} = 100 °C	6 A				6A				6 A			
Non-repetitive peak forward current		85 A	360 A	180 A	800 A	85 A	360 A	180 A	800 A	85 A	360 A	180 A	800 A
Base		A = 1/4" UNF-studs at the ends B = 4 pin Super Jumbo (B4D) C = Goliath E = 4 pin Jumbo (B4F) F = A3-20											

HIGH VOLTAGE RECTIFIER STACKS

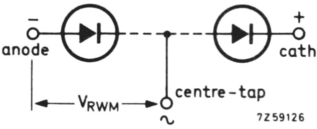
The OSB9110, OSM9110 and OSS9110series are ranges of high voltage rectifier assemblies, incorporating controlled avalanche diodes mounted on fire proof triangular formers. The OSB9110series is intended for application in two phase half wave rectifier circuits. The OSM9110series is intended for application in single phase or three phase bridges or in voltage doubler circuits.

The OSS9110series is intended for all kinds of high voltage rectification. The assemblies are supplied with 1/4"UNF studs or with standard valve bases. The OSB9110-series and OSM9110series are supplied with a centre tap (8-32UNC). The maximum crest working voltages of the OSB9110 and OSM9110series cover the range from 2 kV to 15 kV, and of the OSS9110series the range from 3 kV to 30 kV, in 1 kV steps.

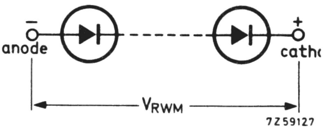
CIRCUIT OSB 9110



CIRCUIT OSM 9110



CIRCUIT OSS 9110



QUICK REFERENCE DATA

		OSB9110	−4	−6	. . .	−28	−30	
		OSM9110	−4	−6	. . .	−28	−30	
Crest working reverse voltage from centre tap to end	V_{RWM}	max.	2	3	. . .	14	15	kV
		OSS9110	−3	−4	. . .	−29	−30	
Crest working reverse voltage	V_{RWM}	max.	3	4	. . .	29	30	kV
Average forward current with R and L load (averaged over any 20 ms period)								
in free air up to T_{amb} = 35 °C	$I_{F(AV)}$	max.					3.5	A
in oil up to T_{oil} = 100 °C	$I_{F(AV)}$	max.					6	A
Non-repetitive peak forward current t = 10 ms; half sine wave; T_j = 175 °C prior to surge	I_{FSM}	max.					85	A

MECHANICAL DATA see pages 4 and 5.

All information applies to frequencies up to 400 Hz

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages								
		OSB9110	−4	−6	...	−28	−30	
		OSM9110	−4	−6	...	−28	−30	
Crest working reverse voltage	V_{RWM}	max.	2	3	...	14	15	kV
		OSS9110	−3	−4	...	−29	−30	
Crest working reverse voltage	V_{RWM}	max.	3	4	...	29	30	kV

Currents

Average forward current (averaged over any 20 ms period)				
in free air up to T_{amb} = 35 °C	$I_{F(AV)}$	max.	3.5	A
in oil up to T_{oil} = 100 °C	$I_{F(AV)}$	max.	6	A
Repetitive peak forward current	I_{FRM}	max.	120	A
Non-repetitive peak forward current t = 10 ms; half sine wave; T_j = 175 °C prior to surge	I_{FSM}	max.	85	A

Reverse power dissipation

		OSB9110	−4	−6	...	−28	−30	
Repetitive peak reverse power		OSM9110	−4	−6	...	−28	−30	
t = 10 µs (square wave; f = 50 Hz) T_j = 175 °C	P_{RRM}	max.	1.2	1.8	...	8.4	9	kW
Non-repetitive peak reverse power t = 10 µs (square wave)								
T_j = 25 °C prior to surge	P_{RSM}	max.	6	9	...	42	45	kW
T_j = 175 °C prior to surge	P_{RSM}	max.	1.2	1.8	...	8.4	9	kW
Repetitive peak reverse		OSS9110	−3	−4	...	−29	−30	
power dissipation t = 10 µs (square wave; f = 50 Hz) T_j = 175 °C	P_{RRM}	max.	1.8	2.4	...	17.4	18	kW
Non-repetitive peak reverse power dissipation t = 10 µs (square wave)								
T_j = 25 °C prior to surge	P_{RSM}	max.	9	12	...	87	90	kW
T_j = 175 °C prior to surge	P_{RSM}	max.	1.8	2.4		17.4	18	kW

Temperatures

Storage temperature	T_{stg}		−55 to +175	°C
Junction temperature	T_j	max.	175	°C

CHARACTERISTICS (See note 1)

			OSB9110 -4 OSM9110-4	-6 -6	...	-28 -28	-30 -30	
Forward voltage								
I_F = 20 A; T_j = 25 °C	V_F	<	4	6	...	28	30	V
Reverse avalanche breakdown voltage 1)								
I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	>	2.5	3.75	...	17.5	18.75	kV
		<	3.76	5.64	...	26.32	28.2	kV

			OSS9110 -3	-4	...	-29	-30	
Forward voltage								
I_F = 20 A; T_j = 25 °C	V_F	<	6	8	...	58	60	V
Reverse avalanche breakdown voltage 1)								
I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	>	3.75	5.0	...	36.25	37.5	kV
		<	5.64	7.52	...	54.52	56.4	kV

Reverse current				
$V_{RM} = V_{RWM\,max}$; T_j = 125 °C	I_{RM}	<	0.6	mA

NOTES

1. The Ratings and Characteristics given apply from centre tap to end. (Not for OSS9110series)
2. Type number suffix

   The suffix consists of a figure indicating the total number of diodes, followed by a letter indicating the base.
   A = 1/4"U.N.F. studs at the ends.
   B = 4 pin Super Jumbo (B4D)
   C = Goliath
   E = 4 pin Jumbo (B4F)
   F = A3-20
3. Operating position

   The rectifier units can be operated at their maximum ratings when mounted in any position.

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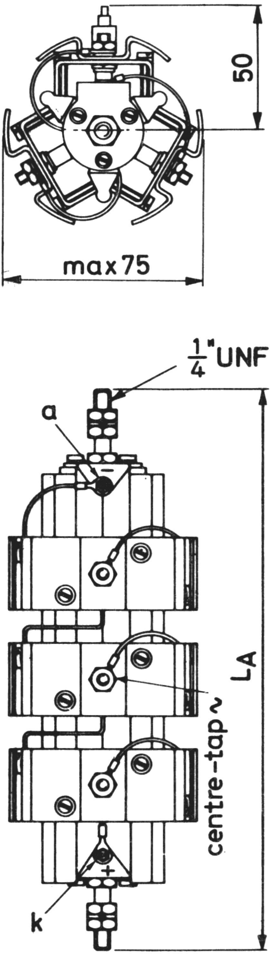
1) The breakdown voltage increases by approximately 0.1 % per °C with increasing junction temperature.

MECHANICAL DATA

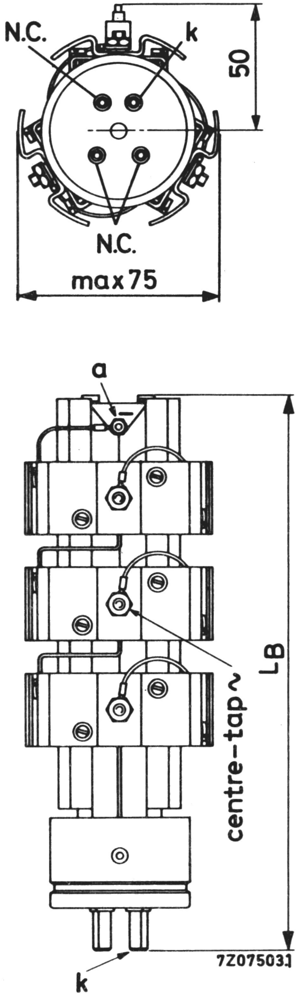
Dimensions in mm

n = total number of diodes

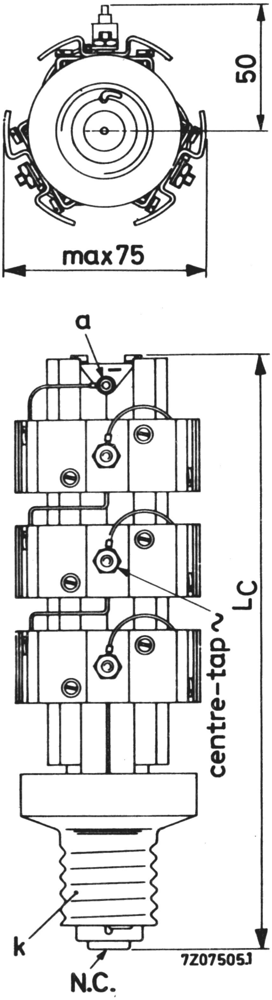
OSM9110-nA


50
max 75
1/4" UNF
a
k
LA
centre-tap ∿
7Z07504.1

OSM9110-nB


N.C.
k
50
N.C.
max 75
a
LB
centre-tap ∿
k
7Z07503.1

OSM9110-nC


50
max 75
a
LC
centre-tap ∿
k
N.C.
7Z07505.1

The drawings show the OSM9110series; the OSB9110 and OSS9110series differ in the following respects:

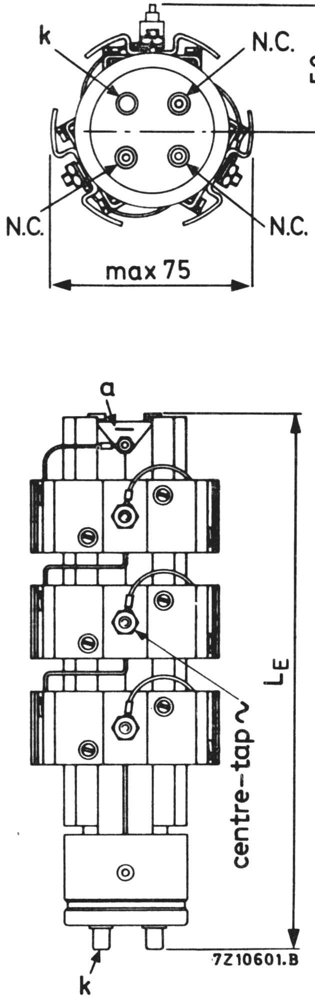
OSB9110series – terminals marked a(-) and k(+) in the drawings are both marked ∿ ; the centre-tap is marked + (instead of ∿ as in the drawings).

OSS9110series – has no centre-tap.

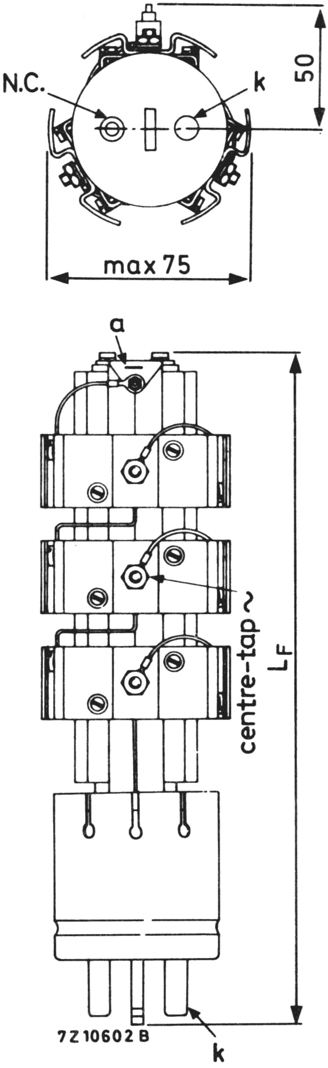
MECHANICAL DATA (continued)

n = total number of diodes.

OSM9110-nE


k
N.C.
50
N.C.
N.C.
max 75
a
L_E
centre-tap ~
k
7Z10601.B

OSM9110-nF

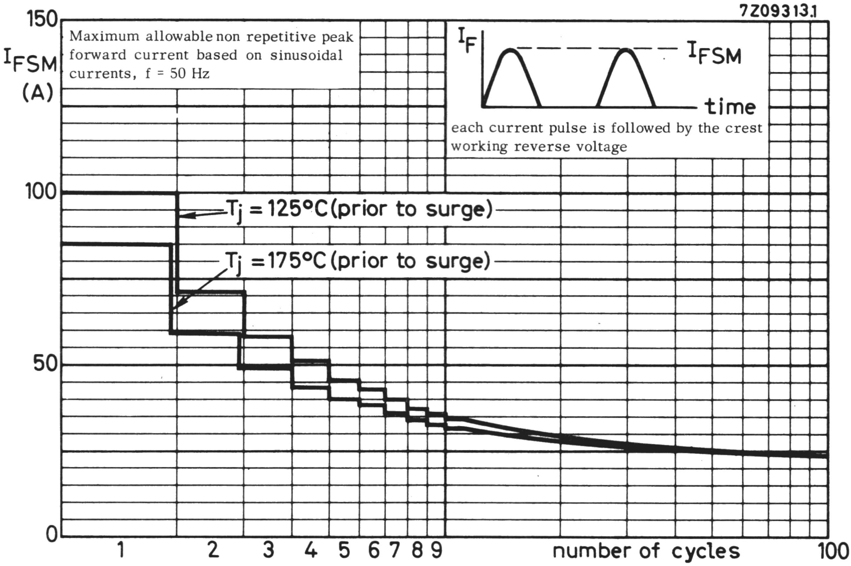

N.C.
k
50
max 75
a
centre-tap ~
L_F
7Z10602 B
k

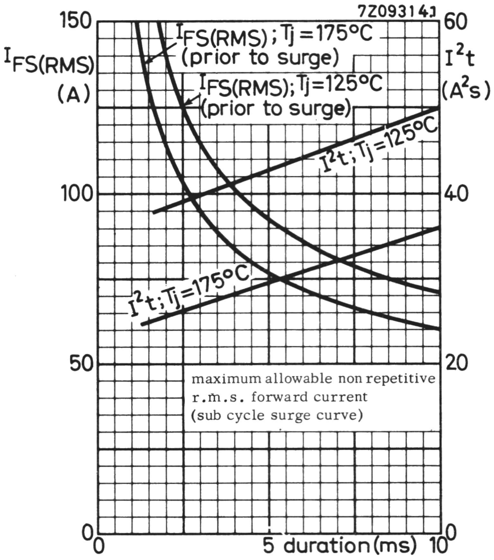
For lengths and weights see table on page 6.

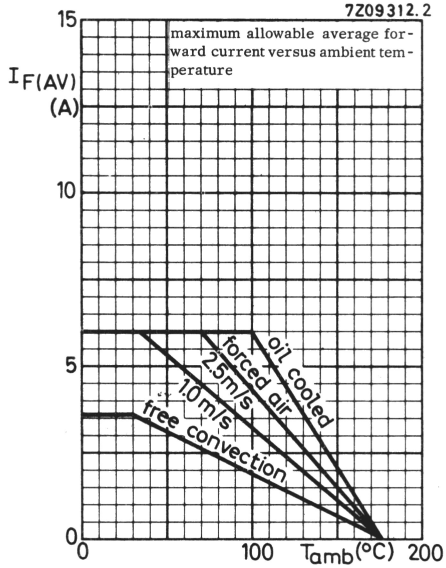
Table of lengths and weights (mm and g)

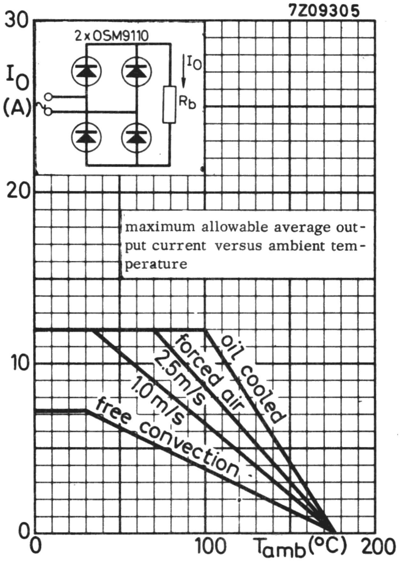
number of diodes	n	3	4 to 6	7 to 9	10 to 12	13 to 15
maximum lengths	L_A	143	184	224	264	305
	L_B	147	188	228	268	309
	L_C	159	199	239	279	320
	L_E	132	173	213	253	294
	L_F	184	225	265	305	346
weights	W_A	153	286	419	552	685
$W_B = W_C =$	W_E	218	351	484	617	750
	W_F	379	512	645	778	911

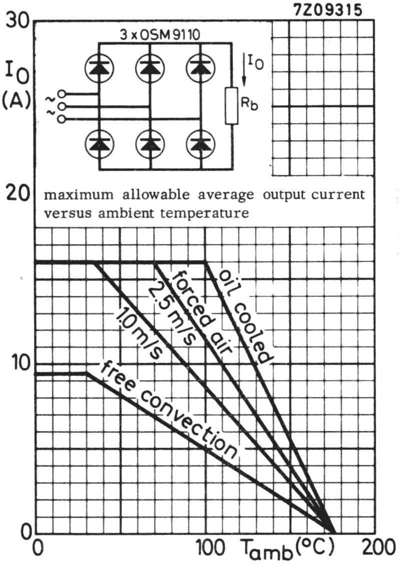
number of diodes	n	16 to 18	19 to 21	22 to 24	25 to 27	28 to 30
maximum lengths	L_A	345	385	426	466	506
	L_B	349	389	430	470	510
	L_C	360	400	441	481	521
	L_E	334	374	415	455	495
	L_F	386	426	467	507	547
weights	W_A	818	951	1048	1217	1350
$W_B = W_C =$	W_E	883	1016	1149	1282	1415
	W_F	1044	1177	1310	1443	1576


7Z09313.1
150
I_{FSM}
(A)
100
50
0
Maximum allowable non repetitive peak forward current based on sinusoidal currents, f = 50 Hz
I_F
I_{FSM}
time
each current pulse is followed by the crest working reverse voltage
T_j = 125°C (prior to surge)
T_j = 175°C (prior to surge)
1
2
3
4
5
6
7
8
9
number of cycles
100


7Z09314.1
150
$I_{FS(RMS)}$
(A)
100
50
0
60
I^2t
(A^2s)
40
20
0
$I_{FS(RMS)}$; T_j = 175°C (prior to surge)
$I_{FS(RMS)}$; T_j = 125°C (prior to surge)
I^2t; T_j = 125°C
I^2t; T_j = 175°C
maximum allowable non repetitive r.m.s. forward current (sub cycle surge curve)
0
5
duration (ms)
10

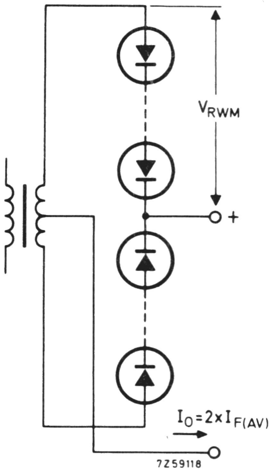

7Z09312.2
maximum allowable average forward current versus ambient temperature
$I_{F(AV)}$ (A)
15
10
5
0
0
100
200
T_{amb} (°C)
oil cooled
forced air
2.5 m/s
1.0 m/s
free convection


7Z09305
2 x OSM9110
I_O
R_b
I_O (A)
30
20
10
0
0
100
200
T_{amb} (°C)
maximum allowable average output current versus ambient temperature
oil cooled
forced air
2.5 m/s
1.0 m/s
free convection

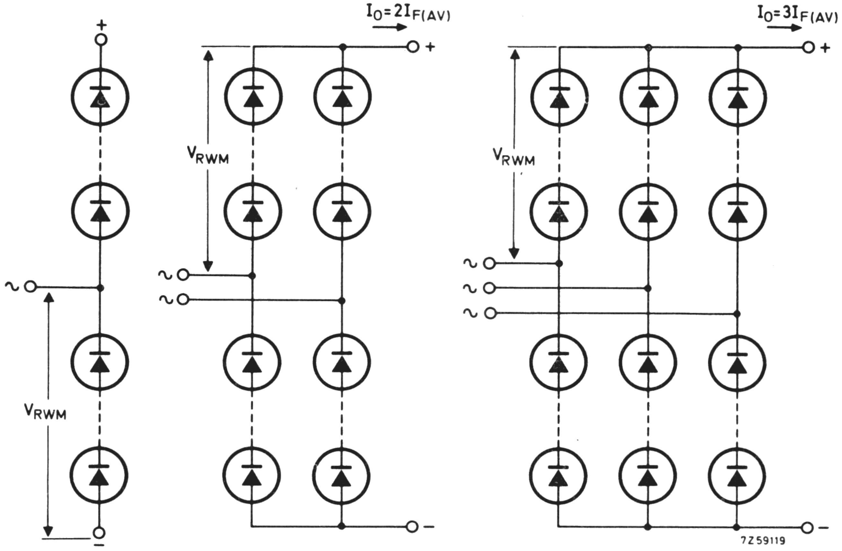

7Z09315
3 x OSM9110
I_O
R_b
I_O (A)
30
20
10
0
0
100
200
T_{amb} (°C)
maximum allowable average output current versus ambient temperature
oil cooled
forced air
2.5 m/s
1.0 m/s
free convection

APPLICATION INFORMATION

OSB9110-4


V_RWM
+
I_O = 2 x I_F(AV)
7Z59118

OSM9110series


+
~
V_RWM
−
I_O = 2I_F(AV)
+
~
~
V_RWM
−
I_O = 3I_F(AV)
+
~
~
~
V_RWM
−
7Z59119

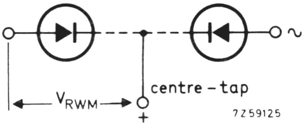
voltage doubler
1x OSM 9110

rectifier circuits with respectively
2x OSM 9110 and 3x OSM 9110

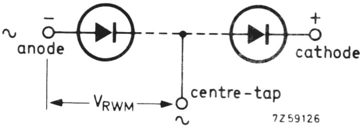
HIGH VOLTAGE RECTIFIER STACKS

The OSB9210, OSM9210 and OSS9210series are ranges of high voltage rectifier assemblies, incorporating controlled avalanche diodes mounted on fireproof triangular formers. The OSB9210series is intended for application in two phase half wave rectifier circuits. The OSM9210series is intended for application in single phase or three phase bridges or in voltage doubler circuits.
The OSS9210series is intended for all kinds of high voltage rectification. The assemblies are supplied with 1/4"UNF studs or with standard valve bases. The OSB9210series and OSM9210series are supplied with a centre tap (8-32UNC). The maximum crest working voltages of the OSB9210 and OSM9210series cover the range from 2 kV to 15 kV, and of the OSS9210series the range from 3 kV to 30 kV, in 1 kV steps.

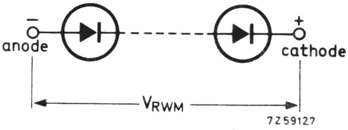
CIRCUIT OSB9210



CIRCUIT OSM9210



CIRCUIT OSS9210



QUICK REFERENCE DATA

		OSB9210	−4	−6	...	−28	−30	
		OSM9210	−4	−6	...	−28	−30	
Crest working reverse voltage from centre tap to end	V_{RWM}	max.	2	3	...	14	15	kV
		OSS9210	−3	−4	...	−29	−30	
Crest working reverse voltage	V_{RWM}	max.	3	4	...	29	30	kV
Average forward current with R and L load (averaged over any 20 ms period)								
in free air up to T_{amb} = 35 °C	$I_{F(AV)}$	max.					5	A
in oil up to T_{oil} = 30 °C	$I_{F(AV)}$	max.					20	A
Non-repetitive peak forward current t = 10 ms; half sine wave; T_j = 175 °C prior to surge	I_{FSM}	max.					360	A

MECHANICAL DATA see page 4 and 5

All information applies to frequencies up to 400 Hz

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

		OSB9210 OSM9210	−4 −4	−6 −6	... ...	−28 −28	−30 −30	
Crest working reverse voltage	V_{RWM}	max.	2	3	...	14	15	kV
		OSS9210	−3	−4	...	−29	−30	
Crest working reverse voltage	V_{RWM}	max.	3	4	...	29	30	kV

Currents

Average forward current (averaged over any 20 ms period) in free air up to T_{amb} = 35 °C	$I_{F(AV)}$	max.	5	A
→ in oil up to T_{oil} = 30 °C	$I_{F(AV)}$	max.	20	A
Repetitive peak forward current	I_{FRM}	max.	440	A
Non-repetitive peak forward current t = 10 ms; half sine wave; T_j = 175 °C prior to surge	I_{FSM}	max.	360	A

Reverse power dissipation

		OSB9210 OSM9210	−4 −4	−6 −6	... ...	−28 −28	−30 −30	
Repetitive peak reverse power t = 10 μs (square wave; f = 50 Hz) T_j = 175 °C	P_{RRM}	max.	4	6	...	28	30	kW
Non-repetitive peak reverse power t = 10 μs (square wave) T_j = 25 °C prior to surge	P_{RSM}	max.	26	39	...	182	195	kW
T_j = 175 °C prior to surge	P_{RSM}	max.	4	6	...	28	30	kW
		OSS9210	−3	−4	...	−29	−30	kW
Repetitive peak reverse power dissipation t = 10 μs (square wave; f = 50 Hz) T_j = 175 °C	P_{RRM}	max.	6	8	...	58	60	kW
Non-repetitive peak reverse power dissipation t = 10 μs (square wave) T_j = 25 °C prior to surge	P_{RSM}	max.	39	52	...	377	390	kW
T_j = 175 °C prior to surge	P_{RSM}	max.	6	8		58	60	kW

Temperatures

Storage temperature	T_{stg}		−55 to +175	°C
Junction temperature	T_j	max.	175	°C

CHARACTERISTICS (See note 1)

			OSB9210 −4	−6	. . .	−28	−30	
			OSM9210−4	−6	. . .	−28	−30	
Forward voltage								
I_F = 50 A; T_j = 25 °C	V_F	<	3.6	5.4	. . .	25.2	27	V
Reverse breakdown voltage [1]								
I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	>	2.5	3.75	. . .	17.5	18.75	kV
		<	3.76	5.64	. . .	26.32	28.2	kV

			OSS9210 −3	−4	. . .	−29	−30	
Forward voltage								
I_F = 50 A; T_j = 25 °C	V_F	<	5.4	7.2	. . .	52.2	54	V
Reverse breakdown voltage [1]								
I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	>	3.75	5.0	. . .	36.25	37.5	kV
		<	5.64	7.52	. . .	54.52	56.4	kV

Reverse current

$V_{RM} = V_{RWM\,max}$; T_j = 125 °C I_{RM} < 0.6 mA

NOTES

1. The Ratings and Characteristics given apply from centre tap to end. (Not for OSS9210series).
2. Type number suffix

   The suffix sonsists of a figure indicating the total number of diodes, followed by a letter indicating the base.
   A = 1/4"U.N.F. studs at the ends.
   B = 4 pin Super Jumbo (B4D)
   C = Goliath
   E = 4 pin Jumbo (B4F)
   F = A3-20
3. Operating position

   The rectifier units can be operated at their maximum ratings when mounted in any position.

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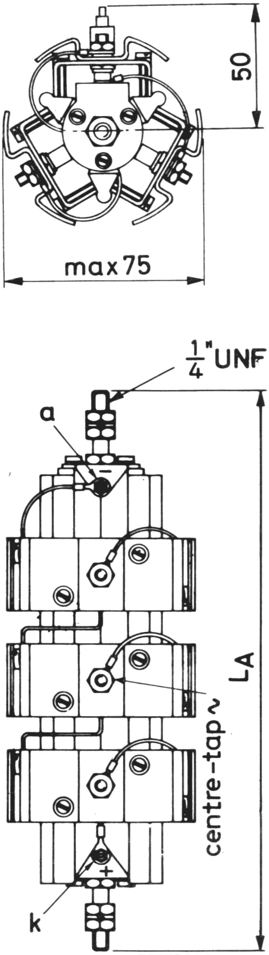
[1] The breakdown voltage increases by approximately 0.1 % per °C with increasing junction temperature.

MECHANICAL DATA

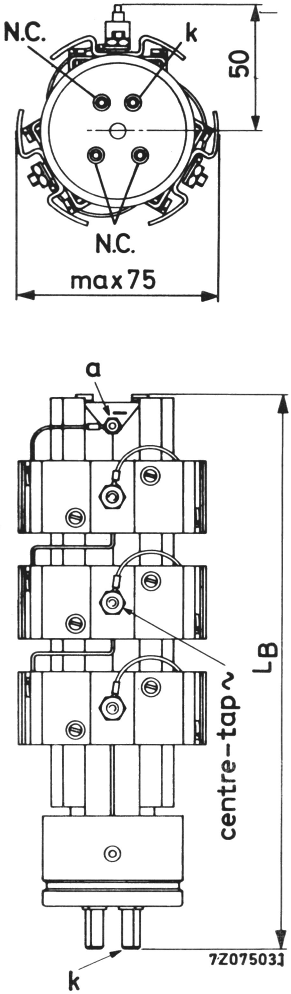
Dimensions in mm

n = total number of diodes

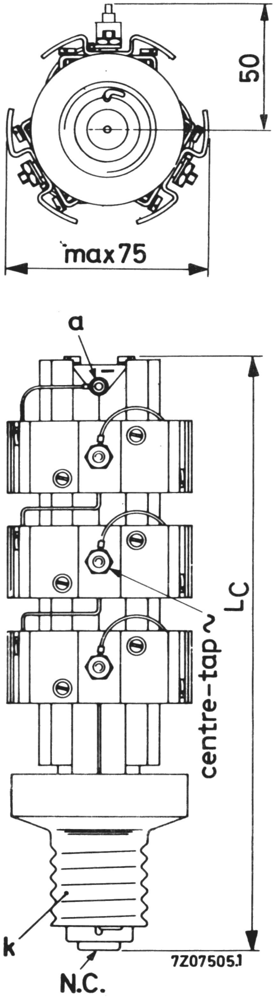
OSM9210-nA


50
max 75
1/4" UNF
a
LA
centre-tap ∼
k
7Z07504.1

OSM9210-nB


N.C.
k
50
N.C.
max 75
a
LB
centre-tap ∼
k
7Z07503.1

OSM9210-nC


50
max 75
a
LC
centre-tap ∼
k
N.C.
7Z07505.1

The drawings show the OSM9210series; the OSB9210 and OSS9210series differ in the following respects:

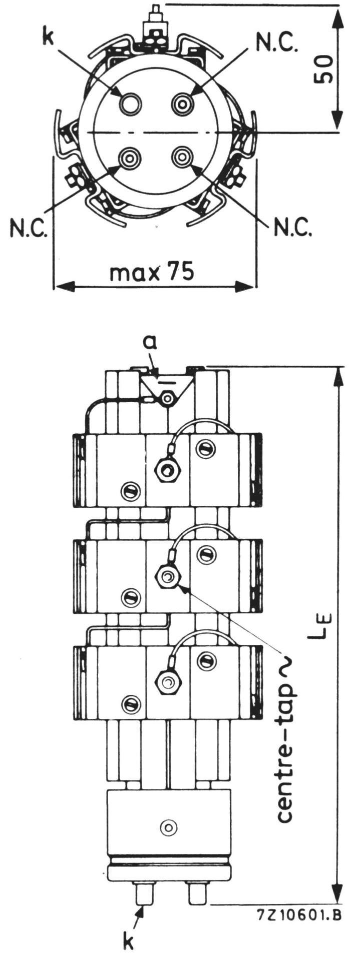
OSB9210series – terminals marked a(-) and k(+) in the drawings are both marked ∼;
the centre-tap is marked + (instead of ∼ as in the drawings).

OSS9210series – has no centre-tap.

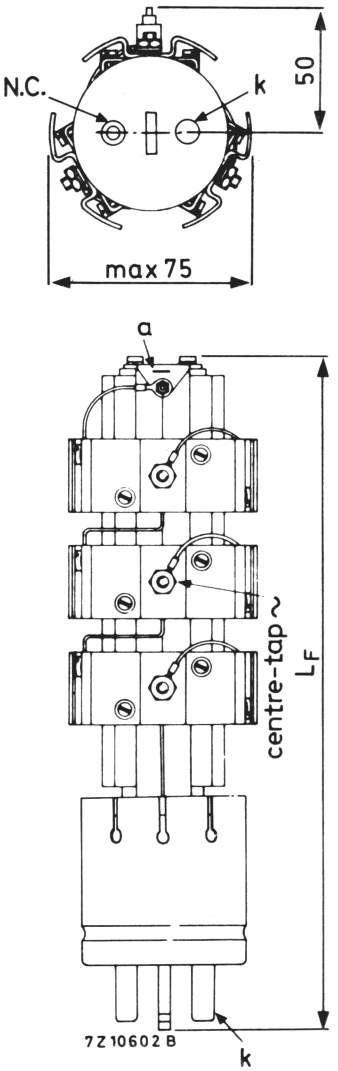
MECHANICAL DATA

n = total number of diodes.

OSM9210-nE


k
N.C.
50
N.C.
N.C.
max 75
a
centre-tap ~
L_E
7Z10601.B
k

OSM9210-nF

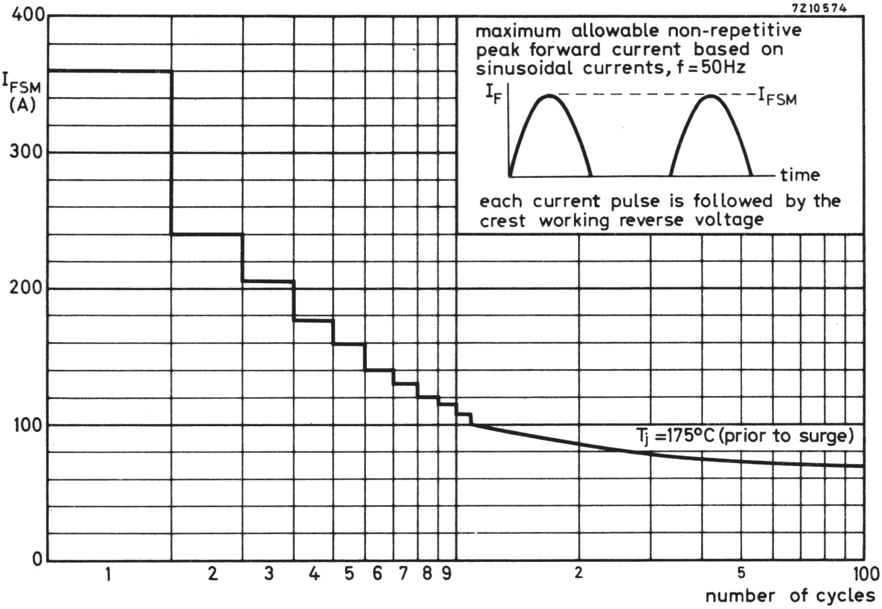

N.C.
k
50
max 75
a
centre-tap ~
L_F
7Z10602 B
k

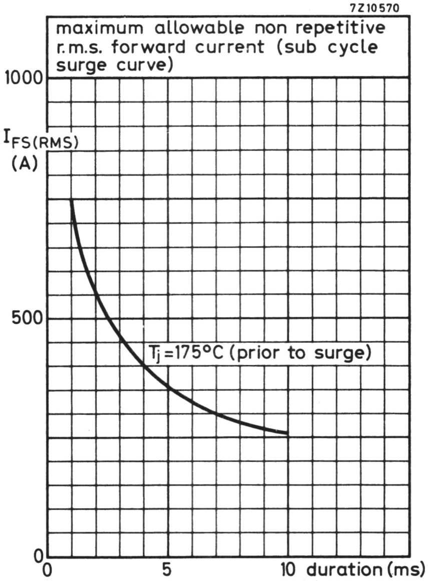
For lengths and weights see table on page 6.

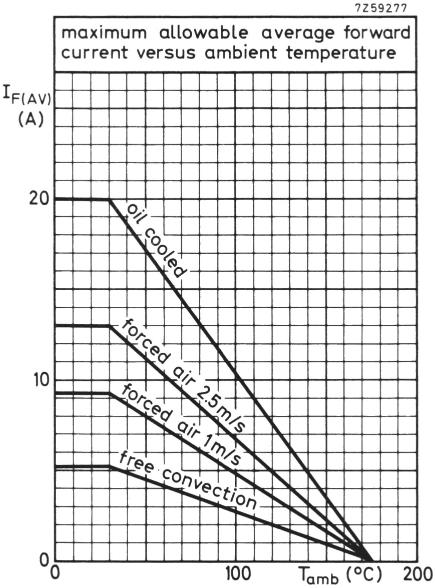
Table of lengths and weights (mm and g)

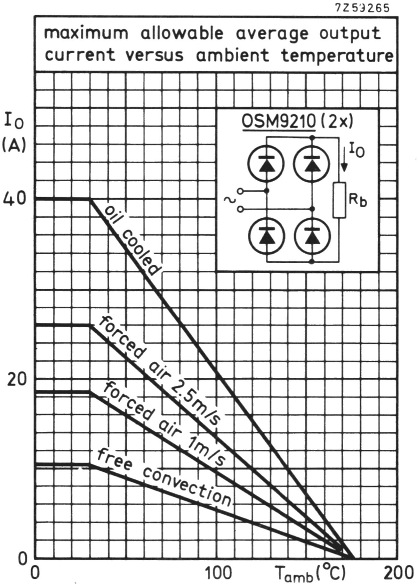
number of diodes	n	3	4 to 6	7 to 9	10 to 12	13 to 15
maximum lengths	L_A	143	184	224	264	305
	L_B	147	188	228	268	309
	L_C	159	199	239	279	320
	L_E	132	173	213	253	294
	L_F	184	225	265	305	346
weight	W_A	153	286	419	552	685
$W_B = W_C =$	W_E	218	351	484	617	750
	W_F	379	512	645	778	911

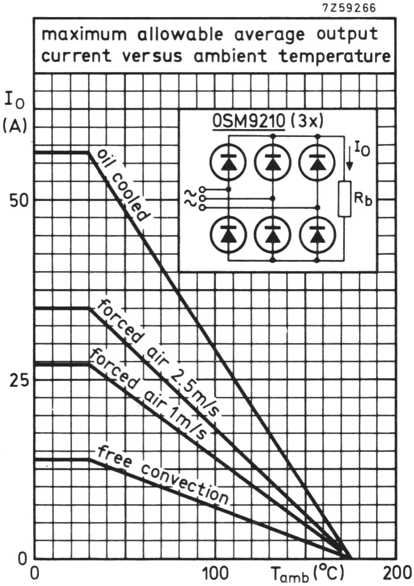
number of diodes	n	16 to 18	19 to 21	22 to 24	25 to 27	28 to 30
maximum lengths	L_A	345	385	426	466	506
	L_B	349	389	430	470	510
	L_C	360	400	441	481	521
	L_E	334	374	415	455	495
	L_F	386	426	467	507	547
weights	W_A	818	951	1084	1217	1350
$W_B = W_C =$	W_E	883	1016	1149	1282	1415
	W_F	1044	1177	1310	1443	1576


7Z10574
maximum allowable non-repetitive peak forward current based on sinusoidal currents, f = 50Hz
I_F
I_FSM
time
each current pulse is followed by the crest working reverse voltage
I_FSM (A)
400
300
200
100
0
1
2
3
4
5
6
7
8
9
2
5
100
number of cycles
Tj = 175°C (prior to surge)


7Z10570
maximum allowable non repetitive r.m.s. forward current (sub cycle surge curve)
I_FS(RMS) (A)
1000
500
0
0
5
10
duration (ms)
Tj = 175°C (prior to surge)

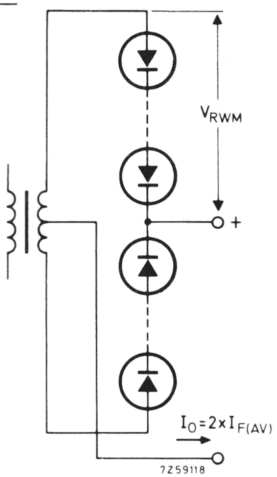

7Z59277
maximum allowable average forward current versus ambient temperature
$I_{F(AV)}$ (A)
20
10
0
0
100
T_{amb} (°C)
200
oil cooled
forced air 2.5m/s
forced air 1m/s
free convection


7Z59265
maximum allowable average output current versus ambient temperature
I_O (A)
40
20
0
0
100
T_{amb} (°C)
200
OSM9210 (2x)
I_O
R_b
~
oil cooled
forced air 2.5m/s
forced air 1m/s
free convection

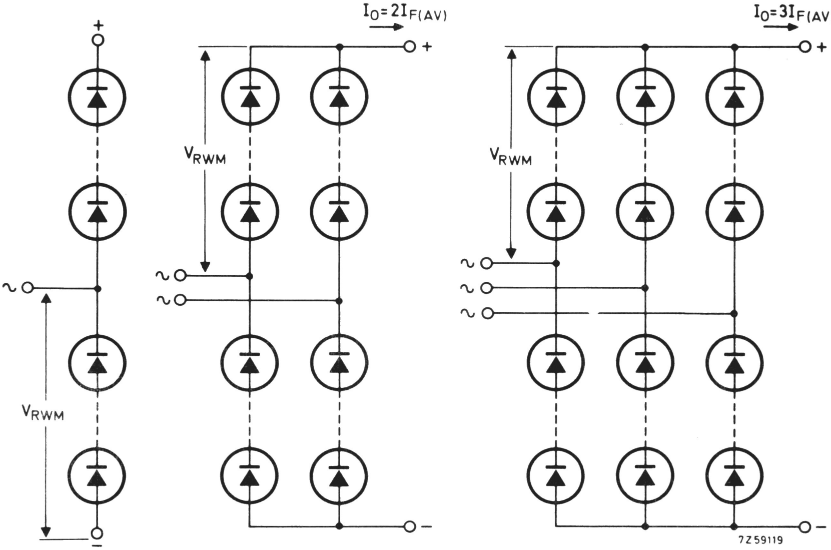

7Z59266
maximum allowable average output current versus ambient temperature
I_O (A)
50
25
0
0
100
T_{amb} (°C)
200
OSM9210 (3x)
I_O
R_b
≈
oil cooled
forced air 2.5m/s
forced air 1m/s
free convection

APPLICATION INFORMATION

OSB9210-4


V_{RWM}
+
$I_O = 2 \times I_{F(AV)}$
7Z59118

OSM9210series


+
~
V_{RWM}
−
$I_O = 2I_{F(AV)}$
+
~
~
V_{RWM}
−
$I_O = 3I_{F(AV)}$
+
~
~
~
V_{RWM}
−
7Z59119

voltage doubler
1x OSM9210

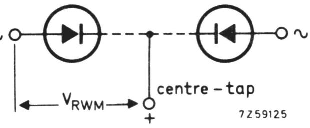
rectifier circuits with respectively
2x OSM9210 and 3x OSM9210

HIGH VOLTAGE RECTIFIER STACKS

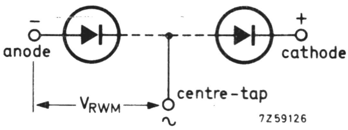
The OSB9310, OSM9310 and OSS9310 series are ranges of high voltage rectifier assemblies, incorporating controlled avalanche diodes mounted on fire proof triangular formers. The OSB9310 series is intended for application in two phase half wave rectifier circuits. The OSM9310 series is intended for application in single phase or three phase bridges or in voltage doubler circuits.

The OSS9310 series is intended for all kinds of high voltage rectification. The assemblies are supplied with 1/4"UNF studs or with standard valve bases. The OSB9310 series and OSM9310 series are supplied with a centre tap (8-32UNC). The maximum crest working voltages of the OSB9310 and OSM9310 series cover the range from 2 kV to 15 kV, and of the OSS9310 series the range from 3 kV to 30 kV, in 1 kV steps.

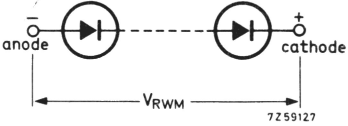
circuit OSB 9310



circuit OSM 9310



circuit OSS 9310



QUICK REFERENCE DATA

		OSB9310	−4	−6	...	−28	−30	
		OSM9310	−4	−6	...	−28	−30	
Crest working reverse voltage from centre tap to end	V_{RWM}	max.	2	3	...	14	15	kV
		OSS9310	−3	−4	...	−29	−30	
Crest working reverse voltage	V_{RWM}	max.	3	4	...	29	30	kV
Average forward current with R and L load (averaged over any 20 ms period)								
in free air up to $T_{amb} = 35^{o}C$	$I_{F(AV)}$	max.					4	A
in oil up to $T_{oil} = 65^{o}C$	$I_{F(AV)}$	max.					12	A
Non-repetitive peak forward current t = 10 ms: half sine wave: $T_j = 175^{o}C$ prior to surge	I_{FSM}	max.					180	A

MECHANICAL DATA see page 4 and 5

All information applies to frequencies up to 400 Hz

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages		OSB9310 OSM9310	-4 -4	-6 -6	...	-28 -28	-30 -30	
Crest working reverse voltage	V_{RWM}	max.	2	3	...	14	15	kV
		OSS9310	-3	-4	...	-29	-30	
Crest working reverse voltage	V_{RWM}	max.	3	4	...	29	30	kV

Currents

Average forward current (averaged over any 20 ms period)				
in free air up to T_{amb} = 35 °C	$I_{F(AV)}$	max.	4	A
in oil up to T_{oil} = 65 °C	$I_{F(AV)}$	max.	12	A
Repetitive peak forward current	I_{FRM}	max.	250	A
Non-repetitive peak forward current t = 10 ms; half sine wave; T_j = 175 °C prior to surge	I_{FSM}	max.	180	A

Reverse power dissipation		OSB9310 OSM9310	-4 -4	-6 -6	...	-28 -28	-30 -30	
Repetitive peak reverse power dissipation t = 10 µs (square wave; f = 50 Hz) T_j = 175 °C	P_{RRM}	max.	2	3	...	14	15	kW
Non-repetitive peak reverse power dissipation t = 10 µs (square wave)								
T_j = 25 °C prior to surge	P_{RSM}	max.	12	18	...	84	90	kW
T_j = 175 °C prior to surge	P_{RSM}	max.	2	3	...	14	15	kW
		OSS9310	-3	-4		-29	-30	
Repetitive peak reverse power dissipation t = 10 µs (square wave; f = 50 Hz) T_j = 175 °C	P_{RRM}	max.	3	4	...	29	30	kW
Non-repetitive peak reverse power dissipation t = 10 µs (square wave)								
T_j = 25 °C prior to surge	P_{RSM}	max.	18	24	...	174	180	kW
T_j = 175 °C prior to surge	P_{RSM}	max.	3	4		29	30	kW

Temperatures

Storage temperature	T_{stg}		−55 to + 175	°C
Junction temperature	T_j	max.	175	°C

CHARACTERISTICS (See note 1)

			OSB9310 −4	−6	...	−28	−30	
Forward voltage			OSM9310 −4	−6	...	−28	−30	
$I_F = 50$ A; $T_j = 25$ °C	V_F	<	5	7.5	...	35	37.5	V
Reverse breakdown voltage 1)								
$I_R = 5$ mA; $T_j = 25$ °C	$V_{(BR)R}$	>	2.5	3.75	...	17.5	18.75	kV
		<	4	6	...	28	30	kV
			OSS9310 −3	−4	...	−29	−30	
Forward voltage								
$I_F = 50$ A; $T_j = 25$ °C	V_F	<	7.5	10	...	72.5	75	V
Reverse breakdown voltage 1)								
$I_R = 5$ mA; $T_j = 25$ °C	$V_{(BR)R}$	>	3.75	5	...	36.25	37.5	kV
		<	6	8	...	58	60	kV

Reverse current

$V_{RM} = V_{RWMmax}$; $T_j = 125$ °C I_{RM} $<$ 0.3 mA

NOTES

1. The Ratings and Characteristics given apply from centre tap to end. (Not for OSS9310series).

2. Type number suffix

   The suffix consists of a figure indicating the total number of diodes, followed by a letter indicating the base.
   A = 1/4" U.N.F. studs at the ends
   B = 4 pin Super Jumbo (B4D)
   C = Goliath
   E = 4 pin Jumbo (B4F)
   F = A3-20

3. Operating position

   The rectifier units can be operated at their maximum ratings when mounted in any position.

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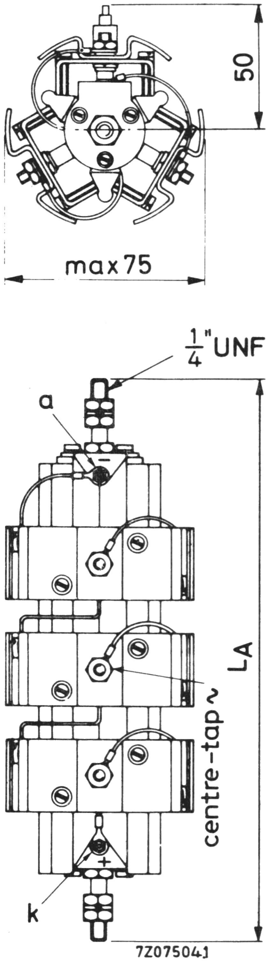
1) The breakdown voltage increases by approximately 0.1% per °C with increasing junction temperature.

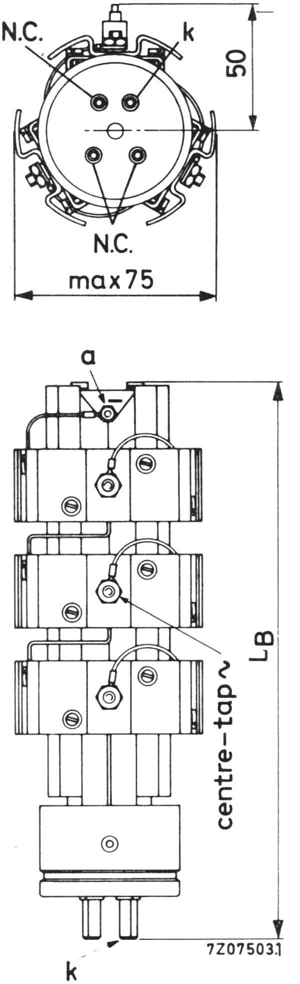
MECHANICAL DATA Dimensions in mm

n = total number of diodes

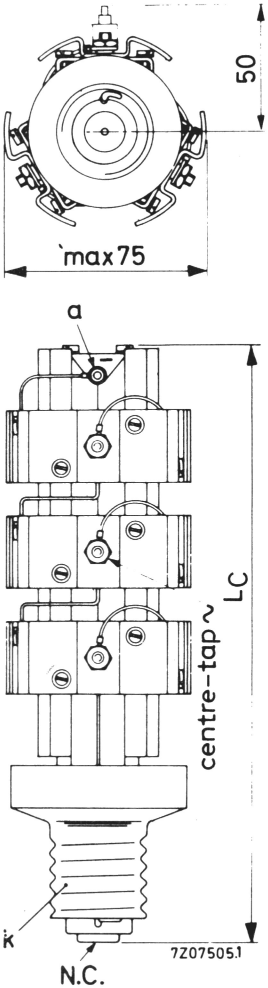
OSM9310-nA


50
max 75
1/4"UNF
a
k
LA
centre-tap ∼
7Z07504.1

OSM9310-nB


N.C.
k
50
N.C.
max 75
a
LB
centre-tap ∼
k
7Z07503.1

OSM9310-nC


50
max 75
a
LC
centre-tap ∼
k
N.C.
7Z07505.1

The drawings show the OSM9310series; the OSB9310 and OSS9310series differ in the following respects:

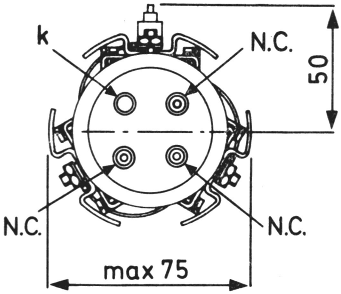
OSB9310series - terminals marked a(-) and k(+) in the drawings are both marked ∼; the centre-tap is marked + (instead of ∼ as in the drawings).

OSS9310series - has no centre-tap.

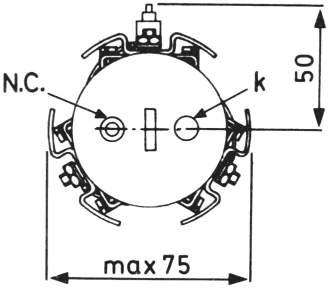
MECHANICAL DATA

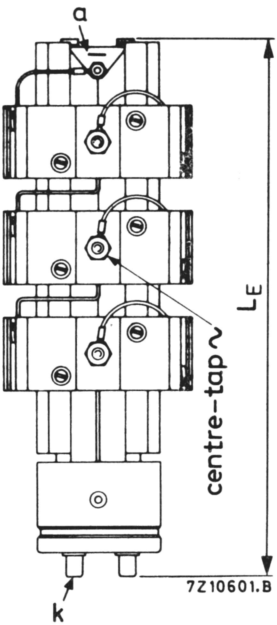
n = total number of diodes

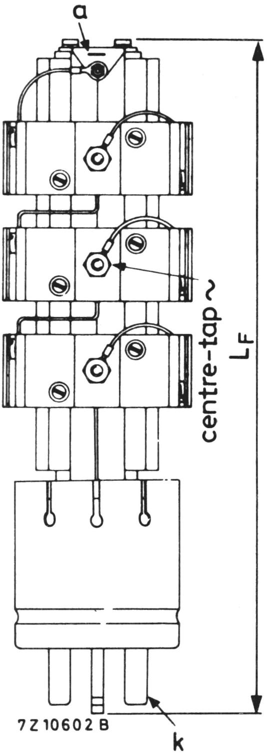
OSM9310-nE


k
N.C.
50
N.C.
N.C.
max 75

OSM9310-nF


N.C.
k
50
max 75


a
centre-tap ~
L_E
k
7Z10601.B

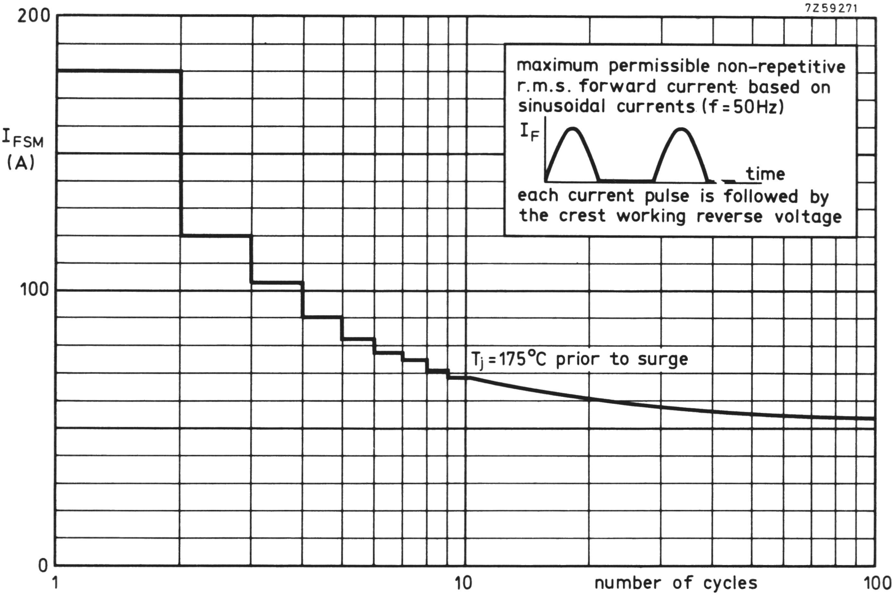

a
centre-tap ~
L_F
7Z10602 B
k

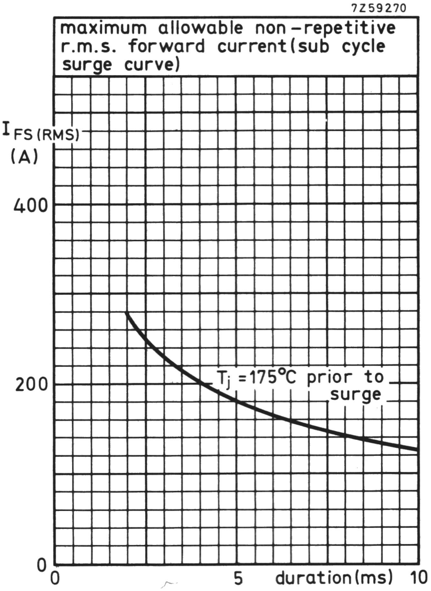
For lengths and weights see table on page 6.

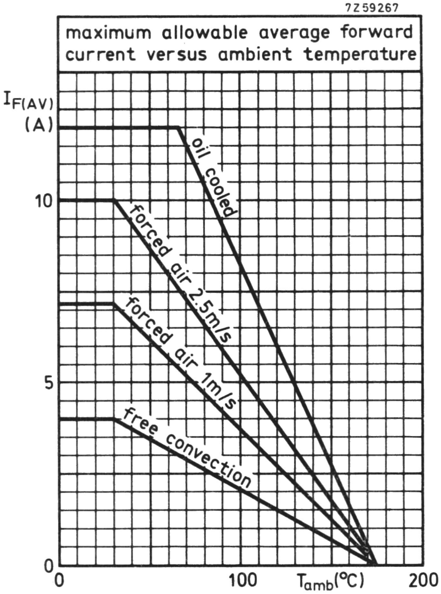
Table of lengths and weights (mm and g)

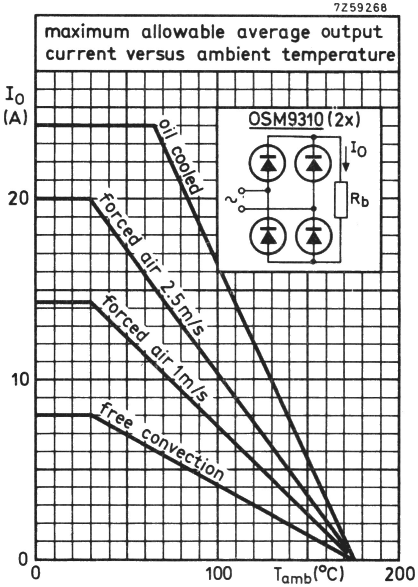
number of diodes	n	3	4 to 6	7 to 9	10 to 12	13 to 15
maximum lengths	L_A	143	184	224	264	305
	L_B	147	188	228	268	309
	L_C	159	199	239	279	320
	L_E	132	173	213	253	294
	L_F	184	225	265	305	346
weight	W_A	153	286	419	552	685
$W_B = W_C =$	W_E	218	351	484	617	750
	W_F	379	512	645	778	911

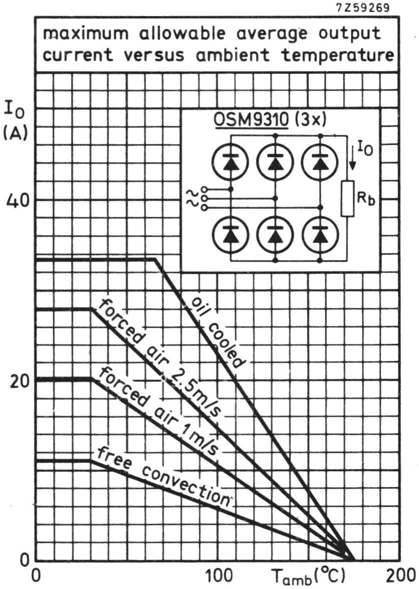
number of diodes	n	16 to 18	19 to 21	22 to 24	25 to 27	28 to 30
maximum lengths	L_A	345	385	426	466	506
	L_B	349	389	430	470	510
	L_C	360	400	441	481	521
	L_E	334	374	415	455	495
	L_F	386	426	467	507	547
weights	W_A	818	951	1084	1217	1350
$W_B = W_C =$	W_E	883	1016	1149	1282	1415
	W_F	1044	1177	1310	1443	1576


7Z59271
200
100
0
I_{FSM}
(A)
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50Hz)
I_F
time
each current pulse is followed by the crest working reverse voltage
T_j = 175°C prior to surge
1
10
number of cycles
100


7Z59270
maximum allowable non-repetitive r.m.s. forward current (sub cycle surge curve)
$I_{FS(RMS)}$
(A)
400
200
0
T_j = 175°C prior to surge
0
5
duration (ms)
10

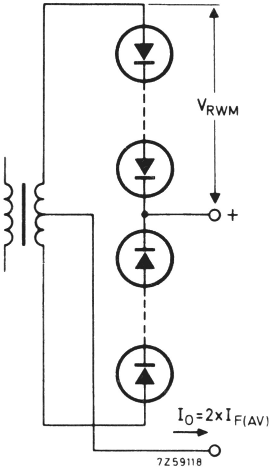

7Z59267
maximum allowable average forward current versus ambient temperature
$I_{F(AV)}$ (A)
10
5
0
0
100
T_{amb}(°C)
200
oil cooled
forced air 2.5m/s
forced air 1m/s
free convection


7Z59268
maximum allowable average output current versus ambient temperature
I_O (A)
20
10
0
0
100
T_{amb}(°C)
200
OSM9310 (2x)
I_O
R_b
~
oil cooled
forced air 2.5m/s
forced air 1m/s
free convection

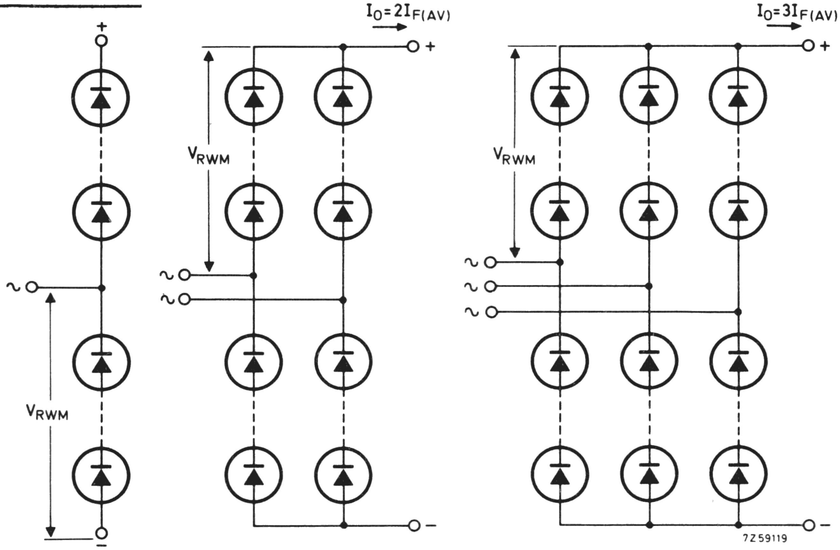

7Z59269
maximum allowable average output current versus ambient temperature
I_O (A)
40
20
0
0
100
T_{amb}(°C)
200
OSM9310 (3x)
I_O
R_b
~
~
oil cooled
forced air 2.5m/s
forced air 1m/s
free convection

APPLICATION INFORMATION

OSB9310series


V_{RWM}
+
$I_O = 2 \times I_{F(AV)}$
7Z59118

OSM9310series


+
~
V_{RWM}
−
$I_O = 2I_{F(AV)}$
+
~
~
V_{RWM}
−
$I_O = 3I_{F(AV)}$
+
~
~
~
V_{RWM}
−
7Z59119

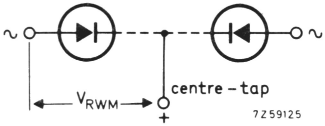
voltage doubler
1x OSM9310

rectifier circuits with respectively
2x OSM9310 and 3x OSM9310

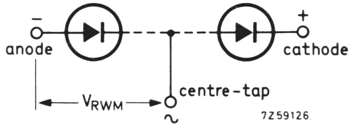
HIGH VOLTAGE RECTIFIER STACKS

Ranges of high voltage rectifier assemblies, incorporating controlled avalanche diodes mounted on fire proof triangular formers. They are supplied with 1/4 "UNF studs.
The OSB9410series is intended for application in two phase half wave rectifier circuits.
The OSM9410series is intended for application in single phase or three phase bridges or in voltage doubler circuits.
The OSS9410series is intended for all kinds of high voltage rectification.
The OSB9410series and OSM9410series are supplied with a centre tap (8-32UNC).
The maximum crest working voltages of the OSB9410 and OSM9410series cover the range from 2 kV to 15 kV, and of the OSS9410series the range from 3 kV to 30 kV, in 1 kV steps.

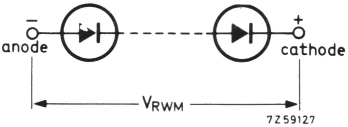
CIRCUIT OSB9410



CIRCUIT OSM9410



CIRCUIT OSS9410



QUICK REFERENCE DATA

		OSB9410	−4	−6	. . .	−28	−30	
		OSM9410	−4	−6	. . .	−28	−30	
Crest working reverse voltage from centre tap to end	V_{RWM}	max.	2	3		14	15	kV
		OSS9410	−3	−4	. . .	−29	−30	
Crest working reverse voltage	V_{RWM}	max.	3	4	. . .	29	30	kV

Average forward current with R and L load (averaged over any 20 ms period)				
in free air up to T_{amb} = 35 °C	$I_{F(AV)}$	max.	10	A
in oil up to T_{oil} = 35 °C	$I_{F(AV)}$	max.	30	A
Non-repetitive peak forward current t = 10 ms; half sine wave; T_j = 175 °C prior to surge	I_{FSM}	max.	800	A

MECHANICAL DATA see page 4

All information applies to frequencies up to 400 Hz

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages								
		OSB9410	-4	-6	...	-28	-30	
		OSM9410	-4	-6		-28	-30	
Crest working reverse voltage	V_{RWM}	max.	2	3	...	14	15	kV
		OSS9410	-3	-4	...	-29	-30	
Crest working reverse voltage	V_{RWM}	max.	3	4	...	29	30	kV

Currents

Average forward current (averaged over any 20 ms period)				
in free air up to T_{amb} = 35 °C	$I_{F(AV)}$	max.	10	A
in oil up to T_{oil} = 35 °C	$I_{F(AV)}$	max.	30	A
Repetitive peak forward current	I_{FRM}	max.	450	A
Non-repetitive peak forward current t = 10 ms; half sine wave; T_j = 175 °C prior to surge	I_{FSM}	max.	800	A

Reverse power dissipation

		OSB9410	-4	-6	...	-28	-30	
Repetitive peak reverse power dissipation		OSM9410	-4	-6	...	-28	-30	
t = 10 μs (square wave; f = 50 Hz) T_j = 175 °C	P_{RRM}	max.	9	13.5	...	63	67.5	kW
Non-repetitive peak reverse power dissipation t = 10 μs (square wave)								
T_j = 25 °C prior to surge	P_{RSM}	max.	55	80	...	375	400	kW
T_j = 175 °C prior to surge	P_{RSM}	max.	8.5	13	...	60.5	65	kW
Repetitive peak reverse power dissipation		OSS9410	-3	-4	...	-29	-30	
t = 10 μs (square wave; f = 50 Hz) T_j = 175 °C	P_{RRM}	max.	13.5	18	...	130.5	135	kW
Non-repetitive peak reverse power dissipation t = 10 μs (square wave)								
T_j = 25 °C prior to surge	P_{RSM}	max.	80	105	...	775	800	kW
T_j = 175 °C prior to surge	P_{RSM}	max.	13	17	...	126	130	kW

Temperatures

Storage temperature	T_{stg}		-55 to +175	°C
Junction temperature	T_j	max.	175	°C

CHARACTERISTICS (See note 1)

			OSB9410 −4	−6	...	−28	−30	
			OSM9410 −4	−6	...	−28	−30	
Forward voltage								
I_F = 150 A; T_j = 25 °C	V_F	<	3.6	5.4	...	25.2	27	V
Reverse avalanche breakdown voltage 1)								
I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	>	2.5	3.75	...	17.5	18.75	kV
		<	4	6	...	28	30	kV

			OSS9410 −3	−4	...	−29	−30	
Forward voltage								
I_F = 150 A; T_j = 25 °C	V_F	<	5.4	7.2	...	52.2	54	V
Reverse avalanche breakdown voltage 1)								
I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	>	3.75	5	...	36.25	37.5	kV
		<	6	8	...	58	60	kV

Reverse current

$V_{RM} = V_{RWMmax}$; T_j = 125 °C I_{RM} < 1.6 mA

NOTES

1. The Ratings and Characteristics given apply from centre tap to end. (Not for OSS9410series).
2. Type number suffix
   The suffix consists of a figure indicating the total number of diodes, followed by a letter indicating the base.
   A = 1/4 "U.N.F. studs at the ends.
3. Operating position
   The rectifier units can be operated at their maximum ratings when mounted in any position.

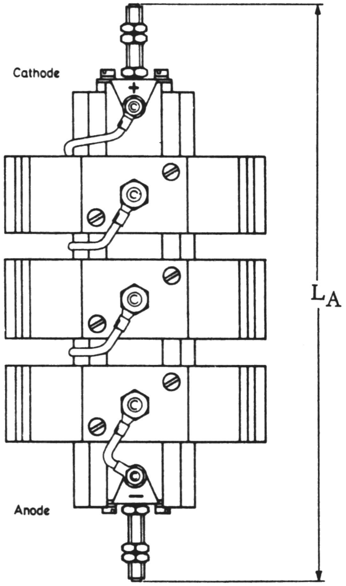
---

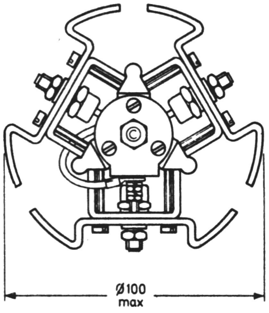
1) The breakdown voltage increases, by approximately 0.1% per °C with increasing junction temperature.

MECHANICAL DATA Dimensions in mm

n = total number of diodes.

OSS9410-nA



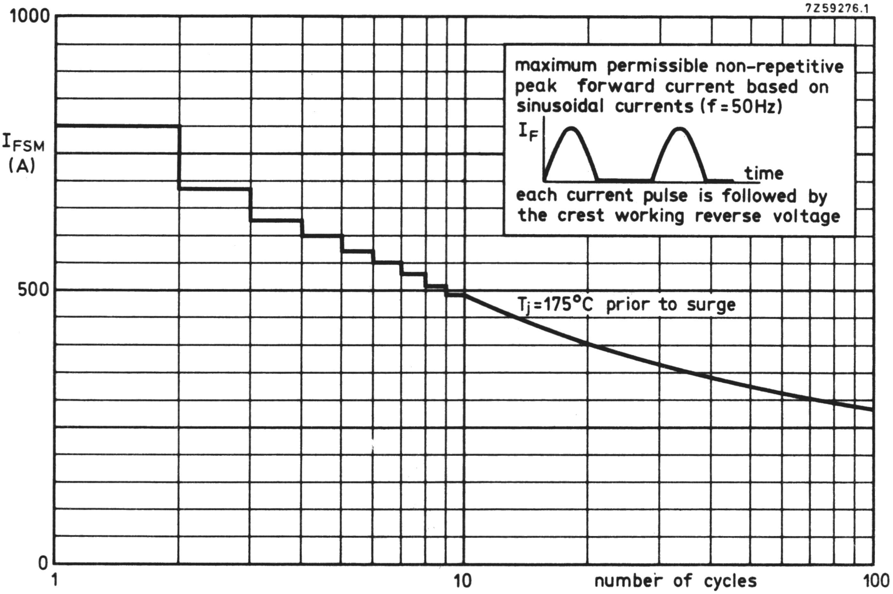


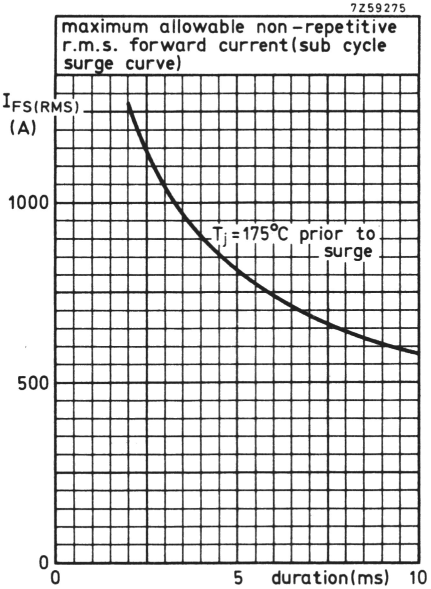
The drawing shows the OSS9410series.
The OSB9410 and OSM9410series differ in the following respects:
OSB9410 series – has a centre tap marked +; anode and cathode terminals are both marked∿.
OSM9410series – has a centre tap marked∿.

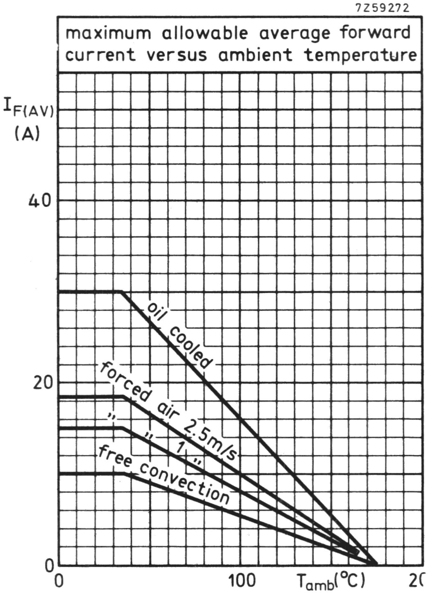
Table of lengths and weights (mm and g)

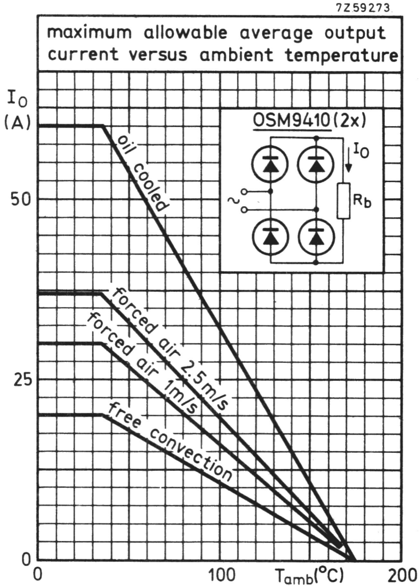
number of diodes n	3	4 to 6	7 to 9	10 to 12	13 to 15
maximum lengths L_A	143	184	224	264	305
weights W_A	215	413	611	809	1007

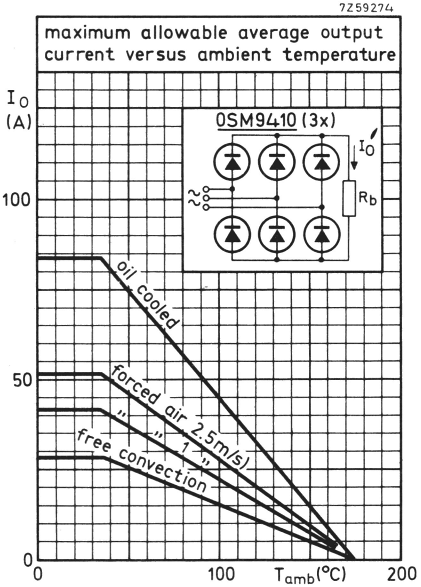
number of diodes n	16 to 18	19 to 21	22 to 24	25 to 27	28 to 30
maximum lengths L_A	345	385	426	466	506
weights W_A	1208	1406	1604	1802	2000


7Z59276.1
1000
500
0
I_FSM (A)
1
10
100
number of cycles
maximum permissible non-repetitive peak forward current based on sinusoidal currents (f = 50Hz)
I_F
time
each current pulse is followed by the crest working reverse voltage
Tj = 175°C prior to surge


7Z59275
maximum allowable non-repetitive r.m.s. forward current (sub cycle surge curve)
I_FS(RMS) (A)
1000
500
0
0
5
10
duration (ms)
Tj = 175°C prior to surge

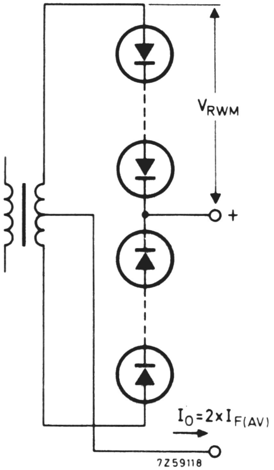

7Z59272
maximum allowable average forward current versus ambient temperature
I_F(AV) (A)
40
20
0
0
100
T_amb (°C)
2(
oil cooled
forced air 2.5m/s
" " 1 "
free convection


7Z59273
maximum allowable average output current versus ambient temperature
I_O (A)
50
25
0
0
100
T_amb (°C)
200
oil cooled
forced air 2.5m/s
forced air 1m/s
free convection
OSM9410 (2x)
I_O
R_b
~

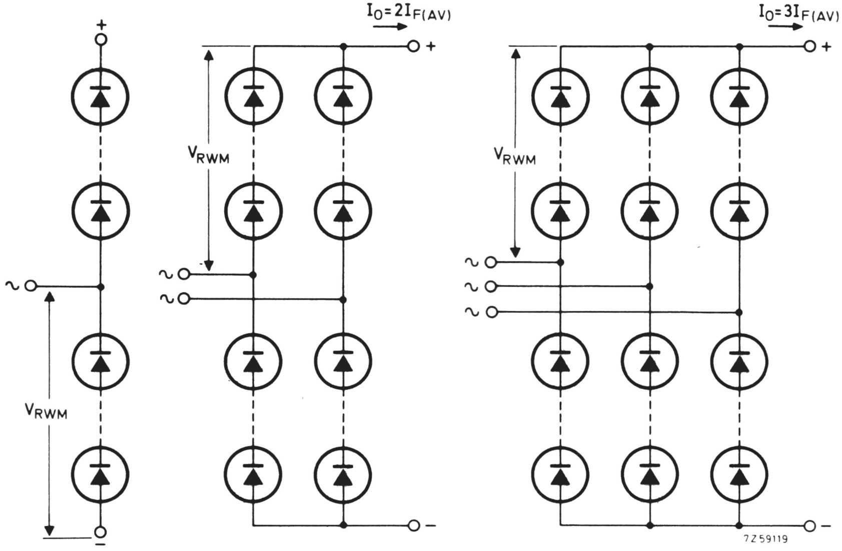

7Z59274
maximum allowable average output current versus ambient temperature
I_O (A)
100
50
0
0
100
T_amb (°C)
200
oil cooled
forced air 2.5m/s
" " 1 "
free convection
OSM9410 (3x)
I_O'
R_b
≈

APPLICATION INFORMATION

OSB9410series


V_{RWM}
+
$I_O = 2 \times I_{F(AV)}$
7Z59118

OSM9410series


+
∼
V_{RWM}
−
$I_O = 2I_{F(AV)}$
+
V_{RWM}
∼
∼
−
$I_O = 3I_{F(AV)}$
+
V_{RWM}
∼
∼
∼
−
7Z59119

voltage doubler
1x OSM9410

rectifier circuits with respectively
2x OSM9410 and 3x OSM9410

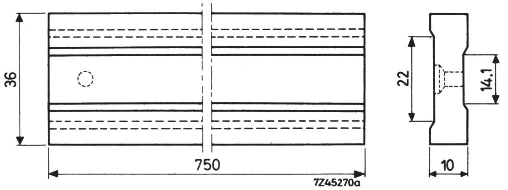
Accessories

MOUNTING STRIPS

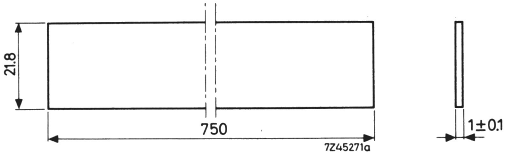
Type 56233 consists of the following components (1 to 2) Dimensions in mm

1\.
1 mounting strip of insulating material

Weight with cover: 330 g


36
750
7Z45270a
22
14.1
10

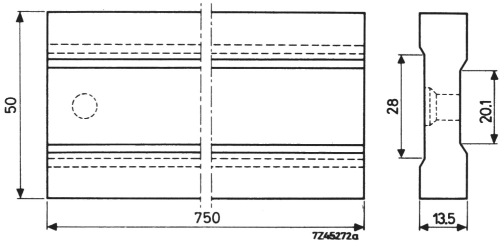
2\.
1 insulating plate


21.8
750
7Z45271a
1±0.1

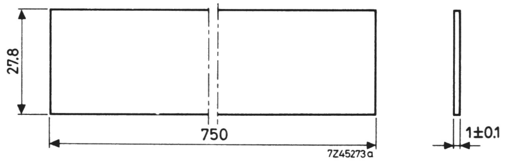
Type 56234 consists of the following components (1 to 2) Dimensions in mm

1\.
1 mounting strip of insulating material

Weight with cover: 615 g


50
750
7Z45272a
28
20.1
13.5

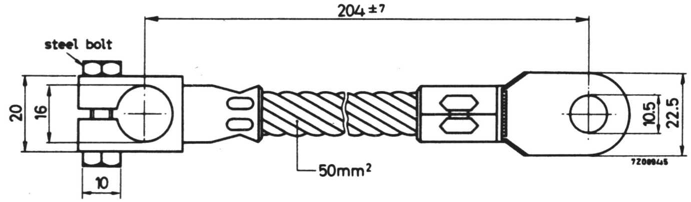
2\.
1 insulating plate


27.8
750
7Z45273a
1±0.1

FLEXIBLE TOP LEADS

56243

MECHANICAL DATA Dimensions in mm

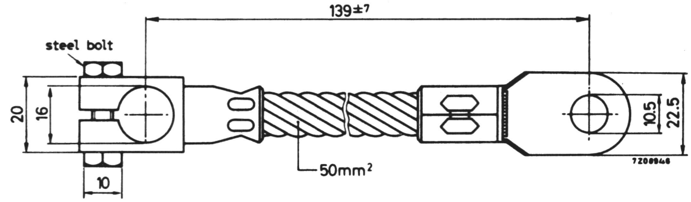

204 ±7
steel bolt
20
16
10
50mm²
10.5
22.5
7Z08945

Weight: 170 g

Top lead 56243 should be used only for $I_{F\,(RMS)} \leq 400$ A.

56243A

MECHANICAL DATA Dimensions in mm


139±7
steel bolt
20
16
10
50mm²
10.5
22.5
7Z08946

Weight: 140 g

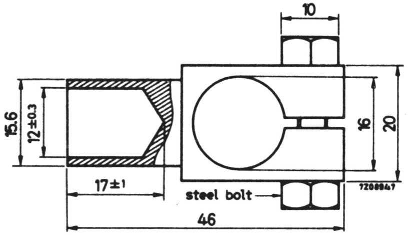
For $I_{F\,(RMS)} > 400$ A, top lead 56243A must be used.
This prevents the temperature of the top connection becoming too high.

CLAMP

56244

MECHANICAL DATA

Dimensions in mm


10
15.6
12±0.3
16
20
17±1
steel bolt
46
7Z08947

MOUNTING INSTRUCTIONS

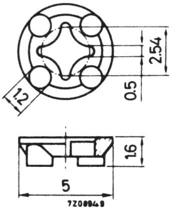
The steel bolt ensures that sufficient torque can be applied to obtain good electrical contact.

56246

DISTANCE DISC

MECHANICAL DATA

Dimensions in mm


2.54
0.5
1.2
1.6
5
7Z08949

Insulating
material

TEMPERATURE

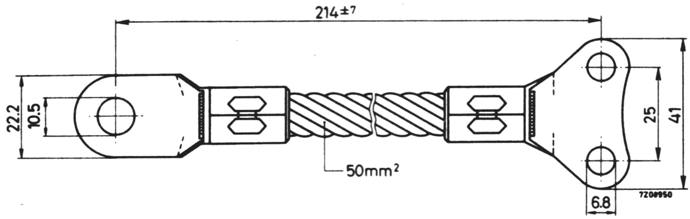
Maximum allowable temperature	T_{max} = 100 °C

56247

FLEXIBLE BASE LEAD

MECHANICAL DATA

Dimensions in mm

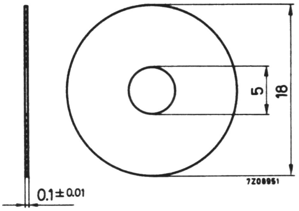

214±7
22.2
10.5
50mm²
25
41
6.8
7Z08950

Weight: 130 g

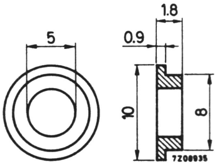
MOUNTING ACCESSORIES

MECHANICAL DATA

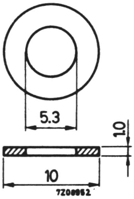
Dimensions in mm


5
18
0.1±0.01
7Z08951

mica washer


5
1.8
0.9
10
8
7Z08935

insulating ring


5.3
1.0
10
7Z08952

plain washer
material: brass, nickel
plated

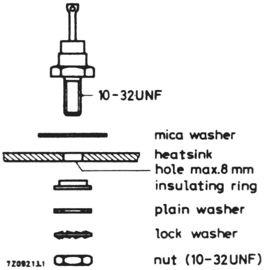
THERMAL RESISTANCE

From mounting base to heatsink (with mica washer) $R_{th\ mb\text{-}h}$ = 5 °C/W

TEMPERATURE

Maximum allowable temperature T_{max} = 125 °C

MOUNTING INSTRUCTIONS

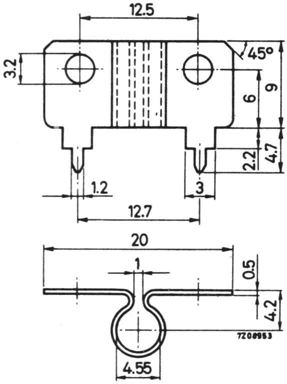

10-32UNF
mica washer
heatsink
hole max.8 mm
insulating ring
plain washer
lock washer
nut (10-32UNF)
7Z09211.1

Notes: When using a tag for electrical contact insert tag between nut and plain washer or replace plain washer by tag.

56263 COOLING FIN

MECHANICAL DATA

Dimensions in mm


12.5
45°
3.2
6
9
2.2
4.7
1.2
3
12.7
20
1
0.5
4.2
4.55
7Z08953

Fin material: copper, tin plated

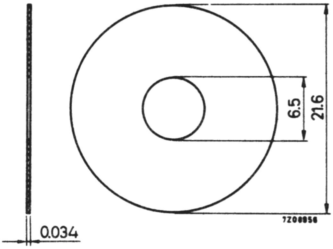
THERMAL RESISTANCE

From case to ambient $R_{th\ c-a} = 100\ ^{0}C/W$

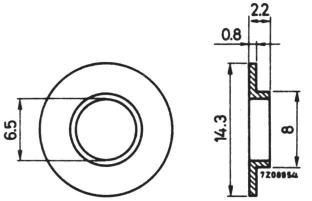
MOUNTING ACCESSORIES

MECHANICAL DATA

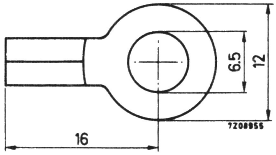
Dimensions in mm


21.6
6.5
0.034
7Z08856

Mica washer


2.2
0.8
6.5
14.3
8
7Z08854

Insulating ring


6.5
12
16
7Z08855

Soldering tag

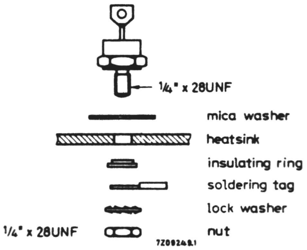
THERMAL RESISTANCE

From mounting base to heatsink with mica washer $R_{th\ mb\text{-}h}$ = 4 °C/W

TEMPERATURE

Maximum allowable temperature T_{max} = 175 °C

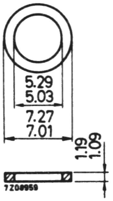
MOUNTING INSTRUCTIONS


1/4" x 28UNF
mica washer
heatsink
insulating ring
soldering tag
lock washer
1/4" x 28UNF
nut
7Z08248.1

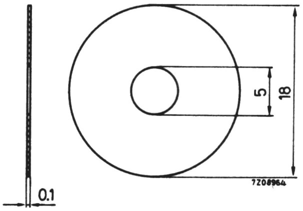
MOUNTING ACCESSORIES

MECHANICAL DATA

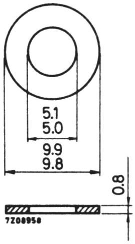
Dimensions in mm


5.29
5.03
7.27
7.01
1.19
1.09
7Z08959

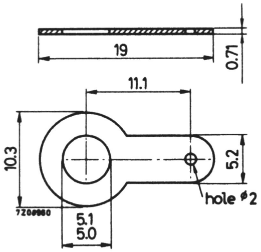
PTFE bush


5
18
0.1
7Z08964

2 mica washers


5.1
5.0
9.9
9.8
0.8
7Z08958

plain washer


19
0.71
11.1
10.3
5.2
hole ⌀2
5.1
5.0
7Z08960

terminal tag

THERMAL RESISTANCE

From mounting base to heatsink

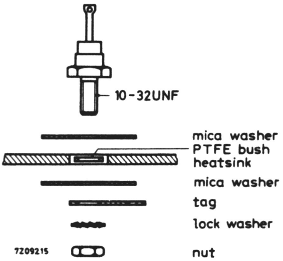
$R_{th\ mb-h} = 5\ ^{o}C/W$

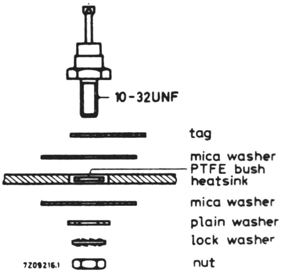
TEMPERATURE

Maximum allowable temperature

$T_{max} = 175\ ^{o}C$

MOUNTING INSTRUCTIONS


10-32UNF
mica washer
PTFE bush
heatsink
mica washer
tag
lock washer
nut
7Z09215

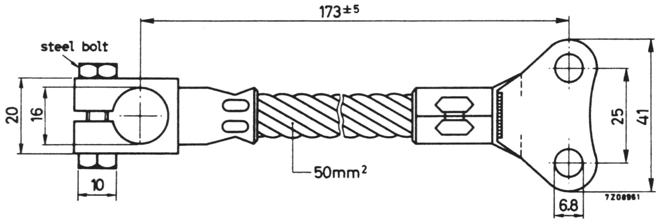

10-32UNF
tag
mica washer
PTFE bush
heatsink
mica washer
plain washer
lock washer
nut
7Z09216.1

FLEXIBLE LEAD FOR SERIES CONNECTION

56296

MECHANICAL DATA

Dimensions in mm

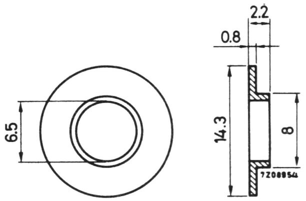

173±5
steel bolt
20
16
10
50mm²
25
41
6.8
7Z08961

INSULATING RING

56299

MECHANICAL DATA

Dimensions in mm


2.2
0.8
6.5
14.3
8
7Z08954

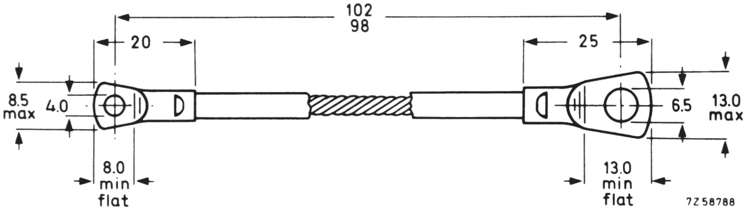
Accessory 56299 is the insulating ring of 56264A.

Maximum operating temperature T_{max} = 175 °C

EXTERNAL LEAD

MECHANICAL DATA

Dimensions in mm

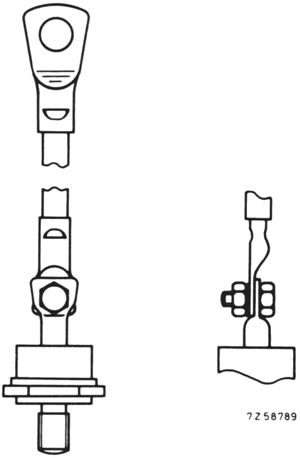

102
98
20
25
8.5
max
4.0
8.0
min
flat
6.5
13.0
max
13.0
min
flat
7Z58788

Net weight: 12 g

56309B: External anode lead (blue lead)

56309R: External cathode lead (red lead)

MOUNTING METHOD



Heatsinks

General
Flat heatsinks
Diecast heatsinks
Heatsink extrusions
Water cooled heatsink

INTRODUCTION

Semiconductor rectifier diodes, thyristors and zener diodes for medium and high power have power losses which cannot be sufficiently transferred to the ambient air by these devices themselves. To prevent excessive junction temperatures the heat transfer capacity has to be improved.
This is achieved by heatsinks, which transfer the dissipated heat from the semiconductor junction to the ambient air by convection and radiation.

A flat metal plate is the simplest form of a heat transfer medium, but it is not the most efficient form for all conditions. In most cases a more complex form of heatsink will have advantages with regard to cost, size and weight.

This chapter offers, apart from information on heat transfer and the mechanical construction of assemblies, useful indications on how to take advantage of reverse-polarity diodes, etc., and, finally, the technical data on three types of heatsink with examples of calculation.

HEAT TRANSFER PATH

In a silicon rectifier the heat is generated inside the silicon wafer. From there the heat flows mainly to the base of the device and then via the heatsink to the surrounding air. The heat flow through heat conductors is analogous to the flow of electric current through electrical conductors. In this analogy the thermal resistance (R_{th} in $^{o}C/W$) corresponds with the electrical resistance (R in Ω).

Fig.1 shows the heat path from the junction to the ambient air as a series connection of three thermal resistances:

$R_{th\ j\text{-}mb}$: The thermal resistance from junction to mounting base. Its value can be found in the data sheets of the relevant semiconductor device.

$R_{th\ mb\text{-}h}$: The contact thermal resistance. This is the thermal resistance from mounting base to heatsink, resulting from the contact area being limited and the contact itself being imperfect. Its value can also be found in the data sheets.

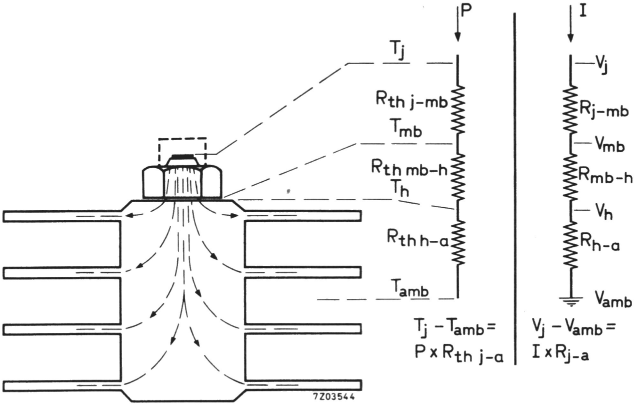
$R_{th\ h\text{-}a}$: The thermal resistance of the heatsink. This is the thermal resistance between the contact surface and the ambient air.

Once the heat has been transferred from heatsink to ambient, cool air must replace the heated air.

According to fig.1 the following formula can be used in heatsink calculations:

$$T_j - T_{amb} = P \times (R_{th\ j\text{-}mb} + R_{th\ mb\text{-}h} + R_{th\ h\text{-}a})$$

Fig.1 Analogy between heat conduction and electric conduction



MEANS TO IMPROVE HEAT TRANSFER

The contact thermal resistance can be made as small as possible by using:

1. a large contact area
2. plane contact surfaces by proper machining, grinding, etc. Heatsinks should be blanked or made burr-free after punching or drilling holes
3. sufficient pressure by applying at least the rated minimum torque. Use a torque spanner
4. silicon grease to fill up air pockets. A thin layer of air has a much higher resistance to heat flow than a thin film of grease (e.g. Dow Corning 340)

The thermal resistance of the heatsink can be reduced by:

1. painting or anodising the surface, which improves heat transfer by radiation
2. higher speed of the cooling air
3. larger size of the heatsink

The air flow can be obtained in the simplest way by natural convection. Any obstruction should be avoided. Therefore fins should be placed vertically, air intake and outlet apertures should be as large as possible. Ample spacing between heatsinks and adjacent structures and provisions to obtain a chimney effect also improve the air flow.

If free convection is not sufficient to remove the heat, a blower or a fan must be used. Forced air cooling also permits a substantially smaller heatsink.

INSULATED MOUNTING

In bridge rectifiers it may be desirable to insulate a diode electrically from its heatsink by means of a mica or teflon wahser. As a consequence the contact thermal resistance will be about 10 times that of the case without insulation. Since the total thermal resistance has a fixed maximum value for given values of P and T_{amb} (see previous section), the increase of $R_{th\ mb-h}$ has to be compensated by a considerable reduction of $R_{th\ h-a}$ (e.g. by using a much larger heatsink).

Furthermore, the creepage distances along the insulator may be too small for the high voltages occurring between diode and heatsink. In fig.2 the creepage distances A and B can be made sufficiently large; but C and D will always be small.

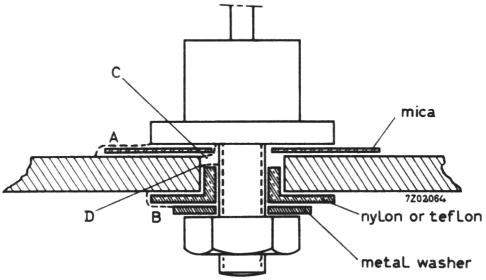


Fig.2 Creepage distances at an insulated diode
(C and D are the critical ones)

CONSTRUCTION OF ASSEMBLIES

In the previous sections some details have been given regarding the proper way of connecting a diode to a heatsink, positioning of heatsinks, etc.

For better current sharing of parallel-connected diodes a good thermal coupling of the devices is needed, which reduces differences in the forward characteristics. Two series-connected diodes should have a good thermal coupling in view of the reverse characteristics.

Thermal coupling can be obtained by mounting two diodes on one heatsink. On a plain cooling fin the two diodes should be mounted according to fig.3, on an extruded aluminium heatsink according to fig.4. A distance between the two diodes equal to one third of the heatsink length provides sufficient thermal coupling. For the electrical connection it is preferred to use a copper strip with a thickness of 1 mm. Mounting two diodes on one heatsink also saves mounting cost.

A flat plate with two diodes should have twice the area necessary for a separately mounted diode.
An extruded aluminium heatsink with two diodes should have twice the length necessary for a separately mounted diode.

An electrical series connection of two diodes mounted on one heatsink can be obtained by using diodes of different polarity. Figs. 5, 6, 7 and 8 show how the combination of normal and reverse-polarity diodes simplifies the assembly of single phase and three phase bridge rectifiers.

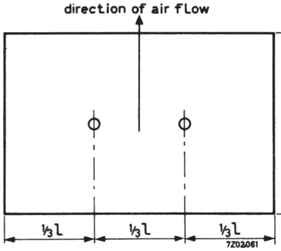

direction of air flow
2/3 l
1/3 l
1/3 l
1/3 l
7Z02061

Fig.3. Dimensioning of a plain cooling fin with two diodes

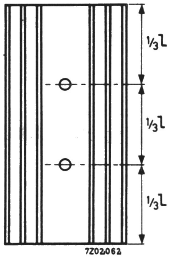

1/3 l
1/3 l
1/3 l
7Z02062

Fig.4. Extruded aluminium heatsink with two diodes

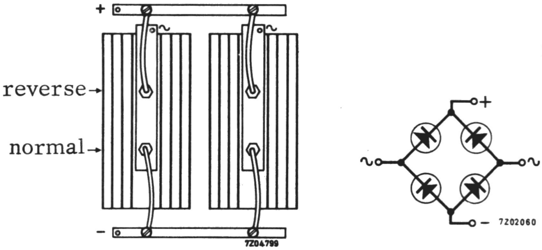

+
~
~
reverse
normal
−
7Z04799
+
~
~
−
7Z02060

Fig.5. Single phase full wave rectifier with diodes of different polarity on extruded aluminium heatsinks

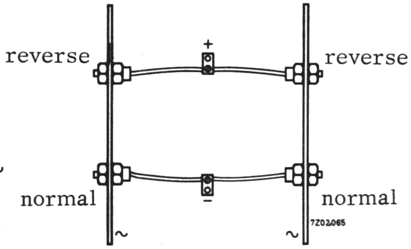

reverse
+
reverse
normal
−
normal
~
~
7Z02065

Fig.6. Single phase full wave rectifier with diodes of different polarity on plain cooling fins (Top view)

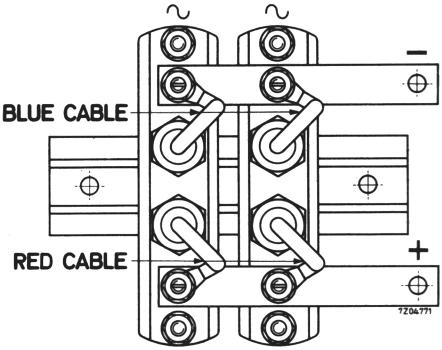

~
~
−
BLUE CABLE
RED CABLE
+
7Z04771

Fig.7. Single phase full wave rectifier with diodes of different polarity (red cable: reverse polarity; blue cable: normal polarity) on two double heatsinks 56250

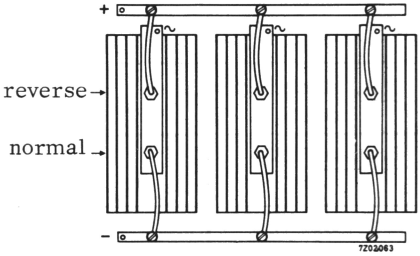
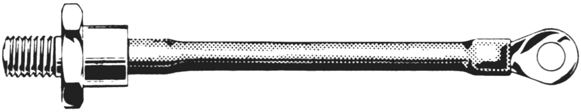

+
~
~
~
reverse
normal
−
7Z02063

Fig.8. Three phase full wave rectifier with diodes of different polarity on extruded aluminium heatsinks

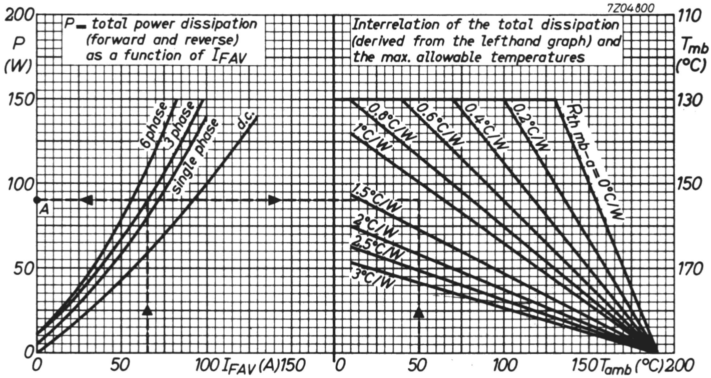
EXAMPLES OF HEATSINK CALCULATION

1. Devices without controlled avalanche properties.
   Assume that the diode of which the outlines are shown, is used in a three phase 50 Hz rectifier circuit at T_{amb} = 50 °C. Further assume: average forward current per diode I_{FAV} = 65 A; contact thermal resistance $R_{th\ mb\text{-}h}$ = 0.1 °C/W



Stud: M12
Mounting base, across the flats: max. 27 mm

From the data of the diode the graph to be used is shown below.



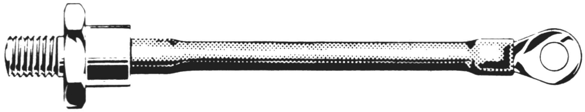
From the lefthand graph it follows that P_{tot} = 90 W per diode (point A).
From the righthand graph it follows that $R_{th\ mb\text{-}a} \approx$ 1.2 °C/W.
Thus $R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h}$ = (1.2 - 0.1) °C/W = 1.1 °C/W.
This may be achieved by different types of heatsinks as shown below.

Type	Free convection	Forced cooling
flat, blackened	–	125 cm^2; 2 m/s or 300 cm^2; 1 m/s
bright	–	175 cm^2; 2 m/s
diecast 56274	–	≈ 1.5 m/s
56280	applicable	
extrusion		
56230 bright	l = 12 cm	l = 5 cm [1]); 1 m/s
blackened	l = 8 cm	l = 5 cm [1]); 1 m/s
56231 bright	l = 7 cm	
blackened	l = 5 cm [1])	

[1]) Practical minimum length

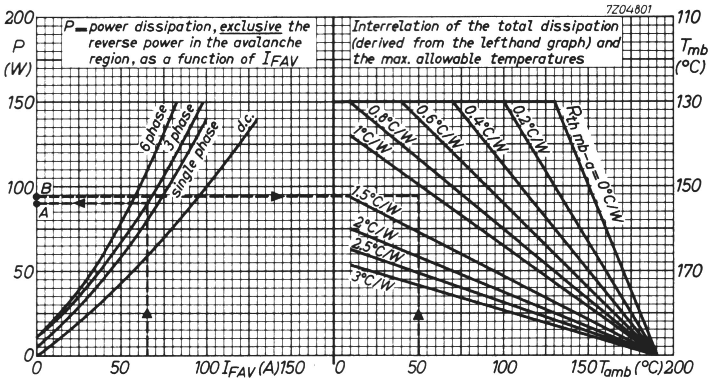
2. Devices with controlled avalanche proporties

Assume that the diode of which the outlines are shown, is used in a three phase 50 Hz rectifier circuit at $T_{amb} = 50\ ^{o}C$. Further assume: average forward current per diode $I_{FAV} = 65$ A; contact thermal resistance $R_{th\ mb\text{-}h} = 0.1\ ^{O}C/W$; repetitive peak reverse power in the avalanche region ($t = 10\ \mu s$) $P_{RRM} = 8$ kW (per diode).



Stud: M12
Mounting base, across the flats: max. 27 mm

From the data of this diode the graph to be used is shown below.



From the lefthand graph it follows that $P_{tot} = 90$ W per diode (point A). The average reverse power in the avalanche region, averaged over any cycle, follows from $P_{RAV} = \delta \times P_{RRM}$, where the duty cycle $\delta = \dfrac{10\ \mu s}{20\ ms} = 0.0005$.

Thus $P_{RAV} = 0.0005 \times 8\ kW = 4\ W$.

Therefore the total device power dissipation $P_{tot} = 90 + 4 = 94$ W (point B). From the righthand graph it follows that $R_{th\ mb\text{-}a} \approx 1.1\ ^{O}C/W$. Hence the heatsink thermal resistance should be:

$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h} = (1.1 - 0.1)\ ^{O}C/W = 1\ ^{O}C/W.$$

A table of applicable heatsinks, similar to that on the foregoing page, can be derived for this case.

SELECTION GUIDE FOR DIODES

To simplify the selection of heatsinks, the table below indicates for each diecast heatsink the diodes for which is may be used.
For extruded heatsinks the most suitable combinations are given.
As an additional guide, the outlines of the appropriate diodes are shown beside the heatsink data.

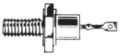
	BYX38 BYX39 BYX50	BYX25 BYX30 BYX40 BYX42 BYX46 BYX48	BYX13	BYX52 BYX56	BYX34 BYX59	BYX23 BYX32	BYX27 BYX33 BYX51
Diecast 56250						●	
56268	●						
56271			●		●		
56274						●	
56277			●				
56278				●			
56280						●	
56283							●
Extrusions 56230 56231		●	●	●	●		
56290	●	●	●				
56293				●	●	●	●

SELECTION GUIDE FOR THYRISTORS

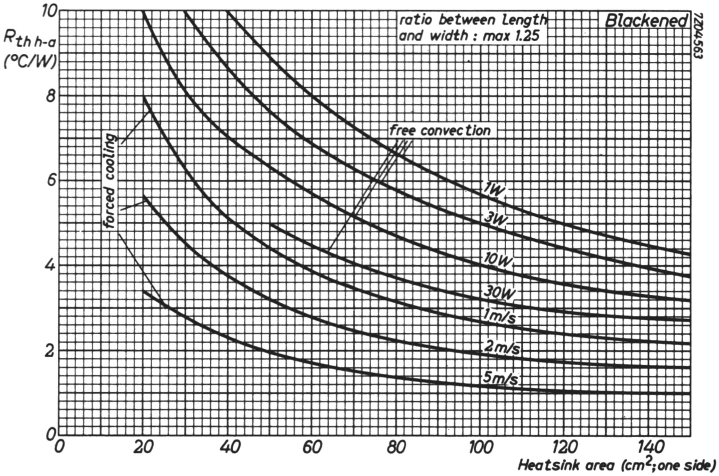
To simplify the selection of heatsinks, the table below indicates for each diecast heatsink the thyristors for which it may be used.
For extruded heatsinks the most suitable combinations are given.
As an additional guide, the outlines of the appropriate thyristors are shown beside the heatsink data.

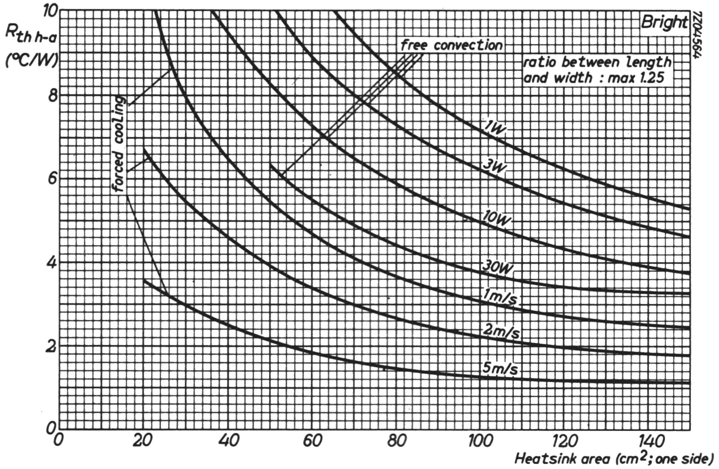
	BT101 BT102 BTY79	BTY87	BTX95	BTW47-U BTW92-U BTX94 BTY91	BTW24-M	BTW23-M	BTW23-U	BTX41
Diecast								
56253		●		●				
56256	●		●					
56268	●		●					
56271					●			
56274						●		
56277					●			
56278				●				
56279							●	
56280						●		
56284								●
56286							●	
Extrusions								
56230 56231		●		●	●	●	●	
56290	●	●	●	●	●			
56293					●	●	●	
Water cooled								
56311								●

Thermal resistance of flat heatsinks of 2 mm copper or 3 mm aluminium.
The graphs are valid for the combination of device and heatsink.

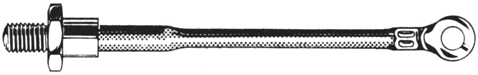


Studs: 10-32UNF
Mounting bases, across the flats: max. 11.0 mm

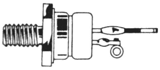




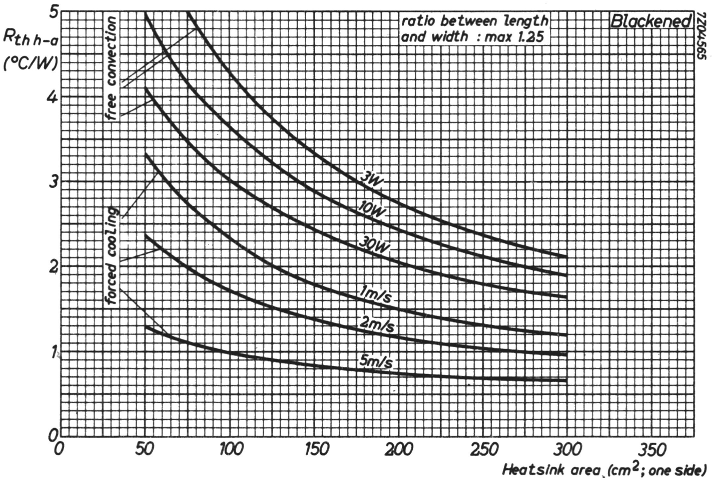
Thermal resistance of flat heatsinks of 2 mm copper or 3 mm aluminium.
The graphs are valid for the combination of device and heatsink.

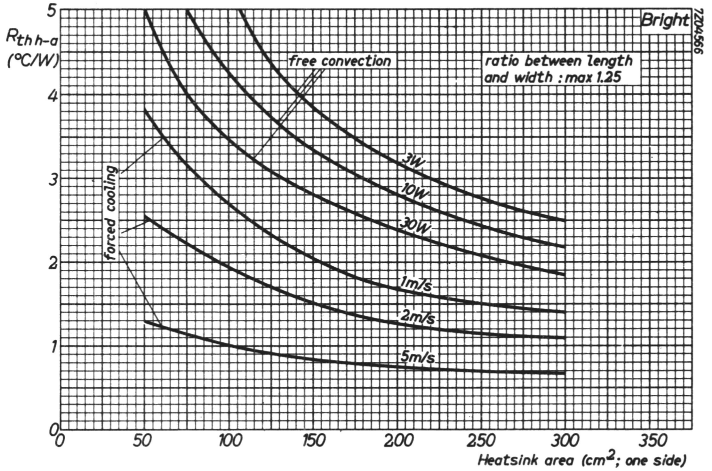


Stud: M8
Mounting base, across the flats: max. 17 mm



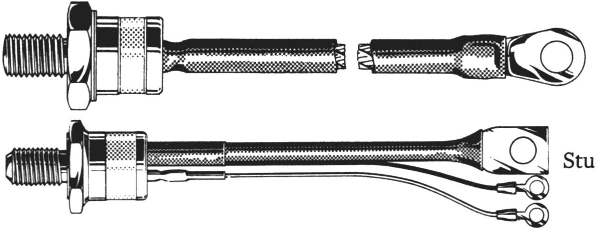
Stud: $\frac{1}{4}$" x 28 UNF
Mounting base, across the flats: max. 14.3 mm



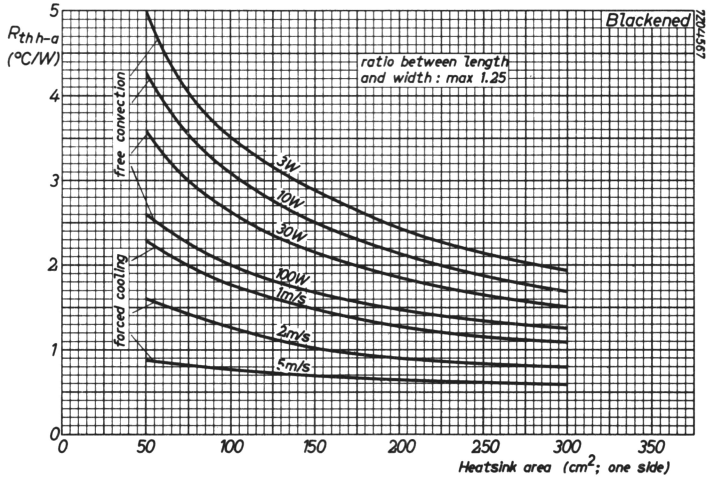


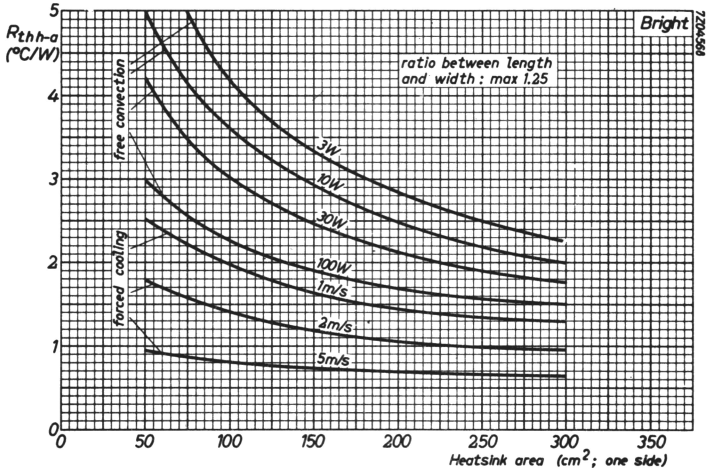
Flat heatsinks

Thermal resistance of flat heatsinks of 2 mm copper or 3 mm aluminium.
The graphs are valid for the combination of device and heatsink.

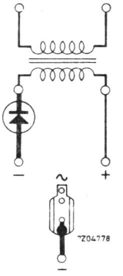
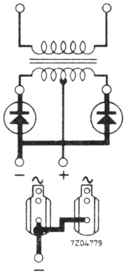
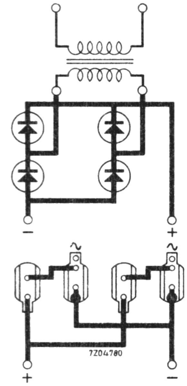
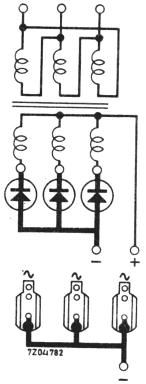


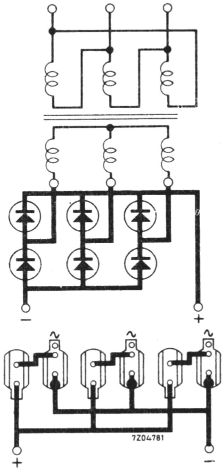
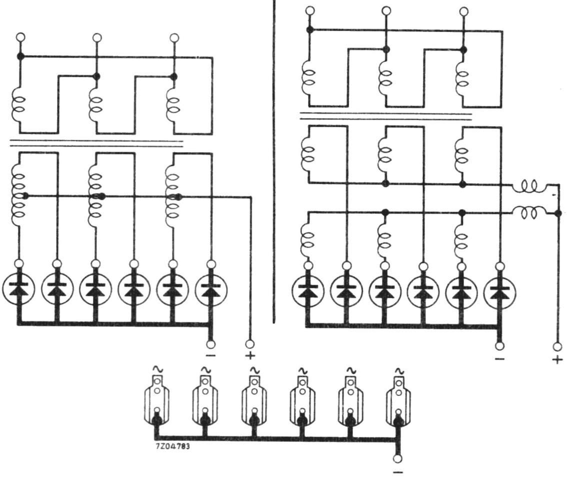
Studs: M12 or $\frac{1}{2}$" x 20UNF

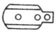


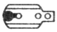


RECTIFIER CIRCUITS ON SINGLE HEATSINKS

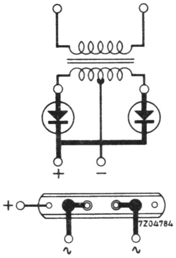
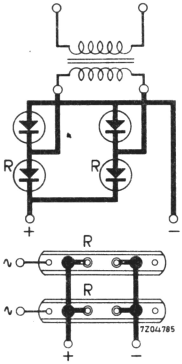
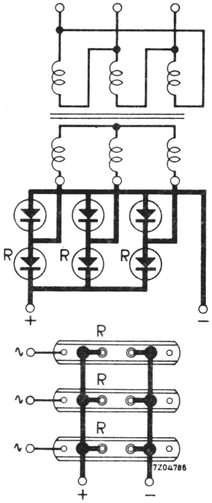
Single phase half wave	Two phase half wave	Single phase full wave (Single phase bridge)	Three phase half wave (Three phase star)
			

Three phase full wave (Three phase bridge)	Six phase half wave (Six phase star)	Three phase double Y with interphase transformer
		

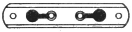
Diecast heatsink without insulator 

Diecast heatsink with insulator 

RECTIFIER CIRCUITS ON DOUBLE HEATSINKS

Two phase half wave	Single phase full wave (Single phase bridge)	Three phase full wave (Three phase bridge)
	 R R + − R ∿ R ∿ 7Z04785 + −	 R R R + − R ∿ R ∿ R ∿ 7Z04786 + −

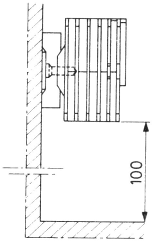
R = Reverse polarity diode

Diecast heatsink 56250 

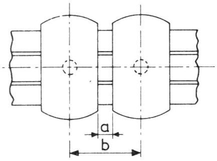
Diecast heatsinks

MOUNTING INSTRUCTION FOR DIECAST HEATSINKS

1. At free convection cooling or forced air flow <0.5 m/s the heatsinks should be mounted with the fins vertical and with a distance to the chassis bottom > 100 mm.

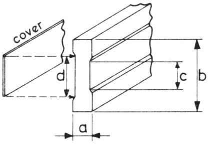


2. At forced air flow > 0.5 m/s the heatsinks may be mounted in any position.
3. Minimum distance between heatsinks in a row.



Heatsink	Distance (mm)	
	a	b
56256/68	> 5.0	>25.0
56277	> 5.0	>40.0
56250/53	>10.0	>50.0
56271/74	>10.0	>50.0

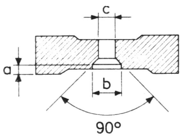
4. The rectifier devices should be fixed to their heatsinks with the torques specified in the relevant published data. Use a torque spanner.
5. For insulated mounting of heatsinks two sizes of mounting strips made of insulating material are available.



Strip	Dimensions (mm)				Weight (g) (with cover)
	a	b	c	d	
56233	10.0	36	14.1	22	330
56234	13.5	50	20.1	28	615

Length 750 mm

6. Mounting holes to be made in the strips:

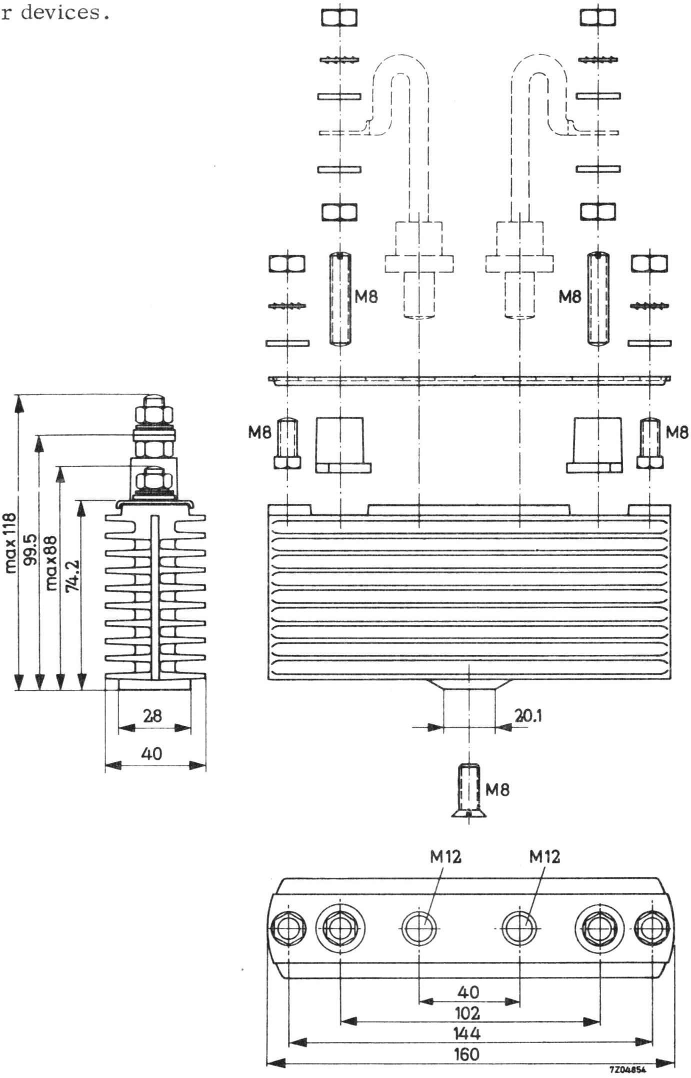


Heatsink	Strip	Dimensions in mm		
		a	b	c
56256/68	56233	< 1.5	7.5	4.3
56253/71	56234	< 1.3	10.2	6.3
56274/77	56234	< 1.3	10.2	6.3
56250	56234	< 1.8	13.8	8.3

DIECAST HEATSINK FOR TWO DEVICES

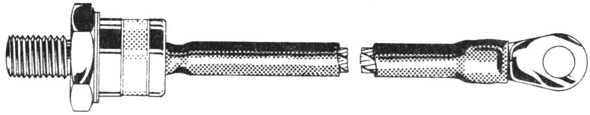
Diecast heatsink of aluminium alloy, painted black, with two M12 tap holes for two rectifier devices.

Dimensions in mm

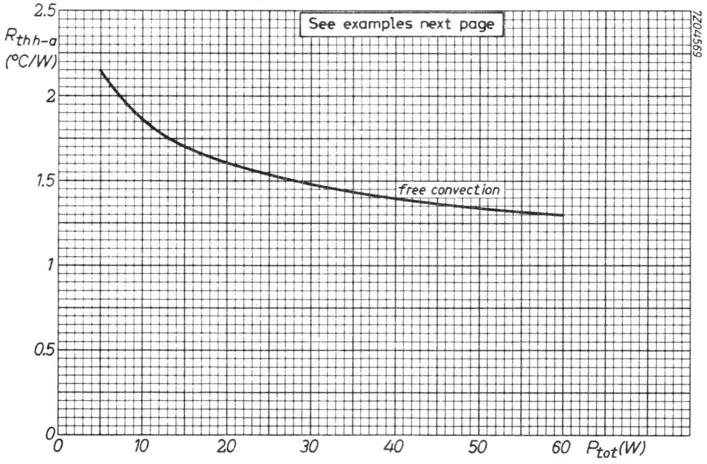

M8
M8
M8
M8
M8
max 118
99.5
max 88
74.2
28
40
20.1
M12
M12
40
102
144
160
7Z04854

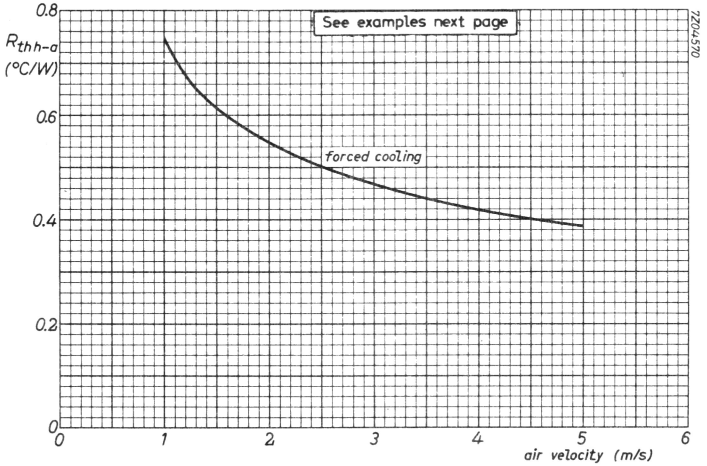
Weight 730 g

The graphs are valid for the combination of device and heatsink.



Stud: M12
Mounting base, across the flats: 27.0 mm





Calculations for the double heatsink 56250

For equal devices at equal conditions the maximum allowable mounting base temperature shall be calculated. After subtraction of the temperature drop caused by the contact thermal resistance the required heatsink thermal resistance can be determined.

For two different devices (with different $T_{j\ max}$, power dissipation and contact thermal resistance) the lower of the two maximum allowable mounting base temperatures shall be taken, after which the same procedure is followed.

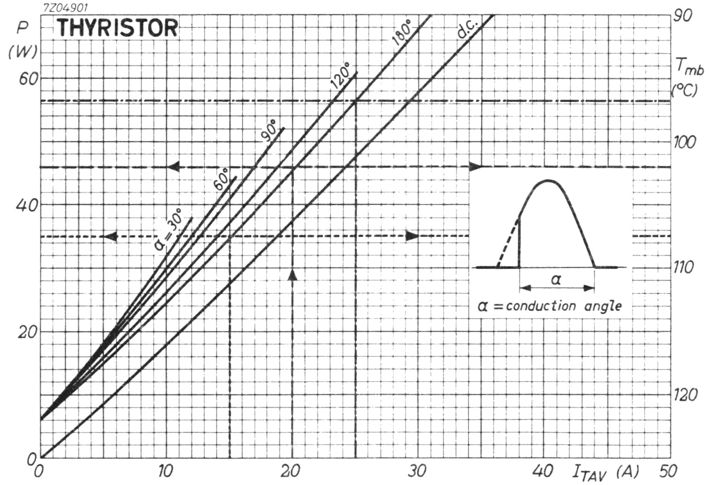
Examples

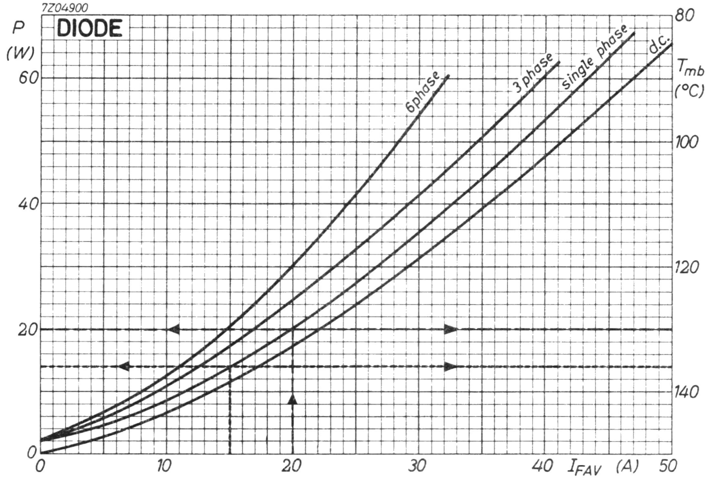
Consider a thyristor T and a diode D, used in single phase application ($\alpha = 180^{o}$), of which the curves to be used are shown on the next page. For all examples the contact thermal resistance $R_{th\ mb\text{-}h} = 0.1\ ^{o}C/W$.
In the table below, three different examples have been worked out.

	$T_1 + D_2$	$T_1 + D_2$	$T_1 + T_2$
Given: T_{amb}	30 °C	50 °C	45 °C
I_{AV}	15 A	20 A	25 A
From next page			
P_1	35 W	46 W	56.5 W
P_2	14 W	20 W	56.5 W
$P_{tot} = P_1 + P_2$	49 W	66 W	113 W
$T_{mb\ 1}$ max.	107.5 °C	102 °C	96.5 °C
$T_{mb\ 2}$ max.	136 °C	130 °C	96.5 °C
$P_1 \times R_{th\ mb\text{-}h} = \Delta T_{mb\text{-}h}$	3.5 °C	4.6 °C	5.7 °C
Maximum T_h	104 °C	97.4 °C	90.8 °C
T_{amb}	30 °C	50 °C	45 °C
Max. $\Delta T_{h\text{-}a}$	74 °C	47.4 °C	45.8 °C
$\frac{\text{Max. } \Delta T_{h\text{-}a}}{P_{tot}} =$	$\frac{74}{49} =$	$\frac{47.4}{66} =$	$\frac{45.8}{113} =$
Max. $R_{th\ h\text{-}a}$	1.5 °C/W	0.72 °C/W	0.4 °C/W
From graphs on foregoing page follows:	Possible with free convection. 50 W: 1.35 °C/W	Only with forced cooling. At least 1.1 m/s	Only with forced cooling. At least 4.5 m/s

Calculations for the double heatsink 56250 (continued)

The two graphs below give the power dissipation and the maximum allowable mounting base temperature versus the average forward current, for the thyristor T and the diode D, respectively.

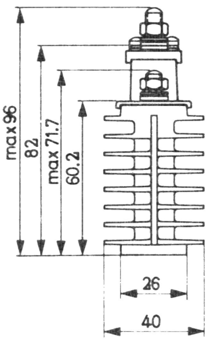


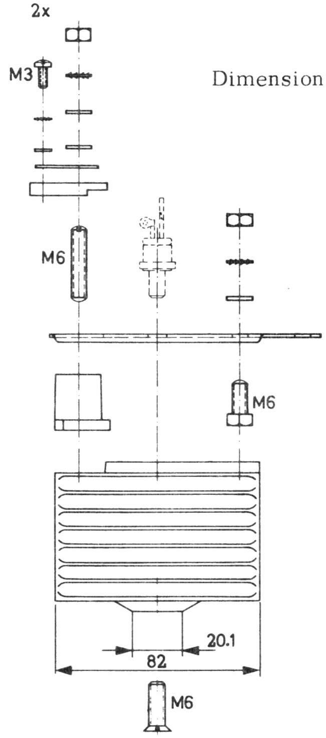


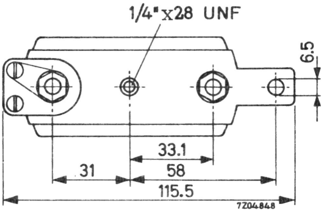
DIECAST HEATSINK

Diecast heatsink of aluminium alloy, painted black, with 1/4"x28 UNF tap hole for rectifier device.

Dimensions in mm

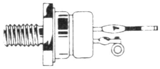

max 96
82
max 71.7
60.2
26
40


2x
M3
M6
M6
82
20.1
M6

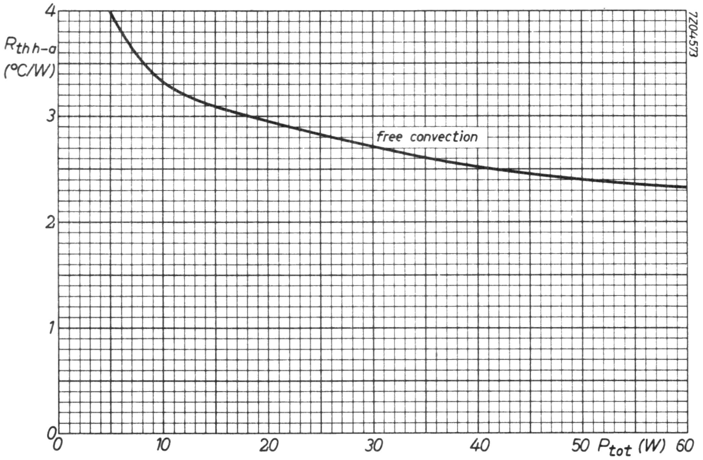

1/4"x28 UNF
6.5
33.1
31
58
115.5
7Z04848

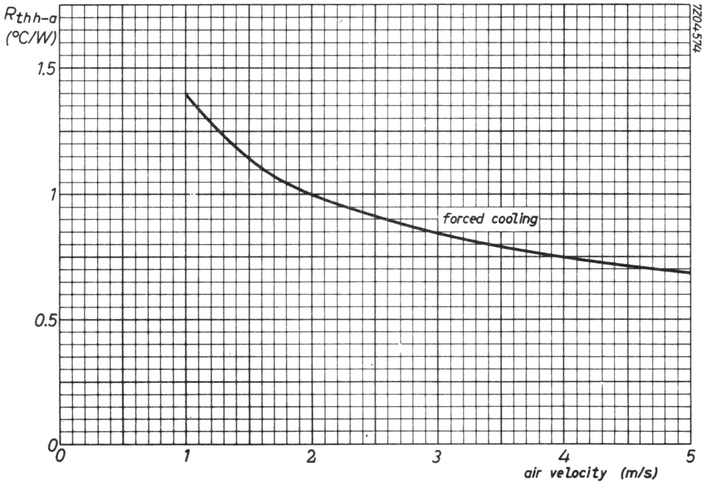
Weight 305 g

The graphs are valid for the combination of thyristor and heatsink.



Stud: $\frac{1}{4}$" x 28UNF
Mounting base, across the flats: max. 14.0 mm



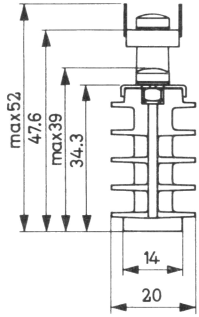


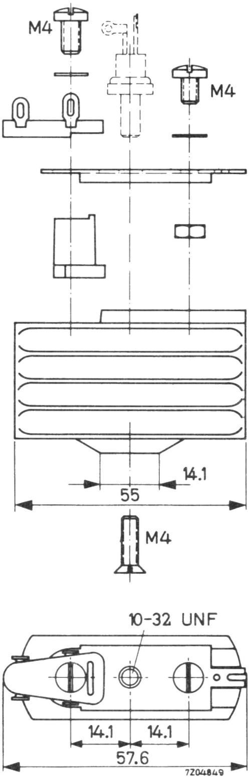
DIECAST HEATSINK

Diecast heatsink of aluminium alloy, painted black, with 10-32 UNF tap hole for rectifier device.

Dimensions in mm

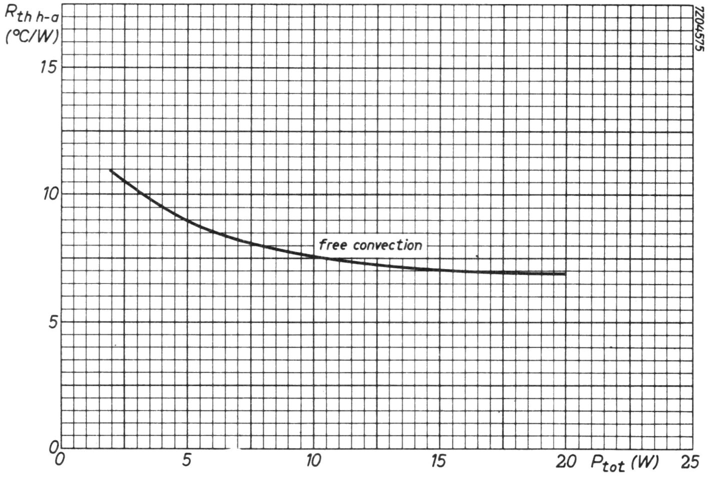
Weight: 55 g

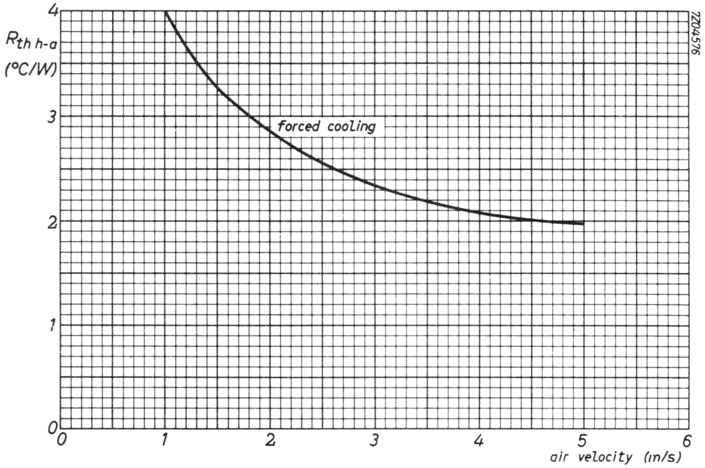

max52
47.6
max39
34.3
14
20


M4
M4
14.1
55
M4
10-32 UNF
14.1
14.1
57.6
7Z04849

The graphs are valid for the combination of thyristor and heatsink.

Stud: 10 - 32UNF
Mounting base, across the flats: 11.0 mm



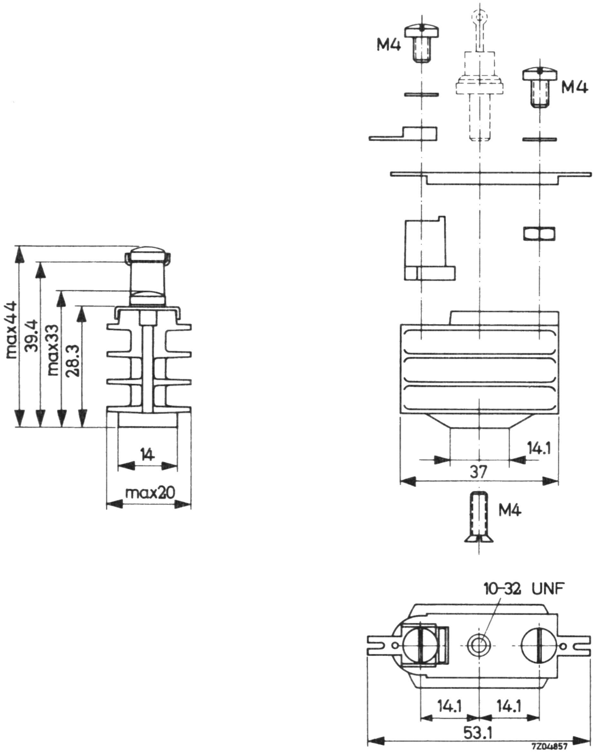


DIECAST HEATSINK

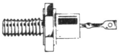
Diecast heatsink of aluminium alloy, painted black, with 10-32 UNF tap hole for rectifier device.

Dimensions in mm

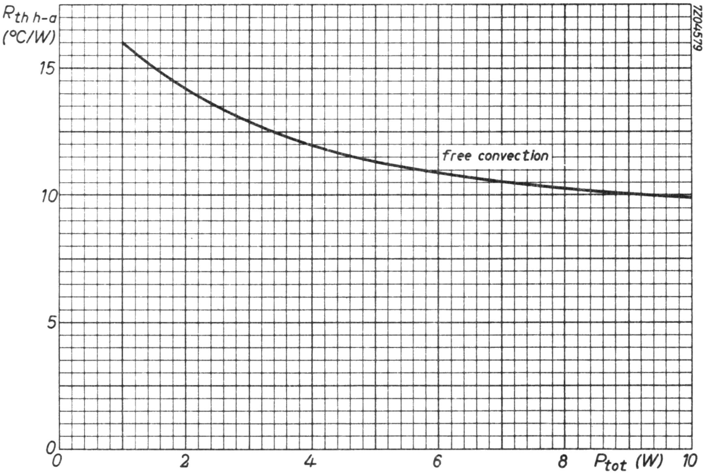
Weight 33 g

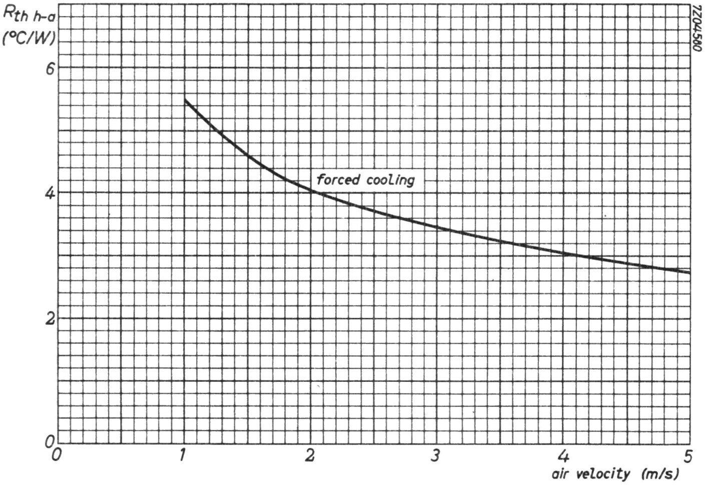

max44
39.4
max33
28.3
14
max20
M4
M4
14.1
37
M4
10-32 UNF
14.1
14.1
53.1
7Z04857

The graphs are valid for the combination of diode and heatsink.



Stud: 10 - 32UNF
Mounting base, across the flats: 11.0 mm



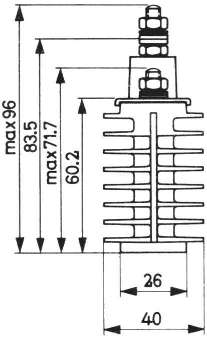


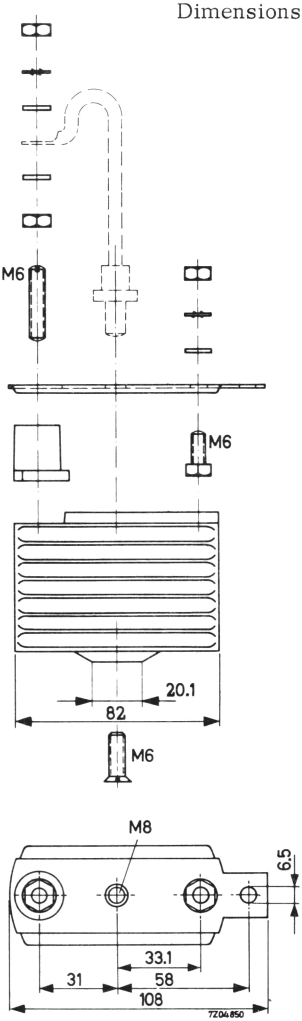
DIECAST HEATSINK

Diecast heatsink of aluminium alloy, painted black, with M8 tap hole for rectifier device.

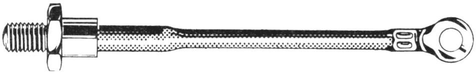
Dimensions in mm

Weight 270 g

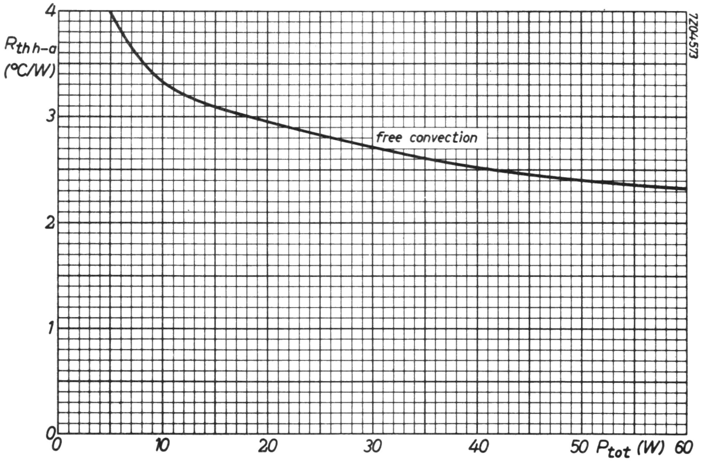

max96
83.5
max71.7
60.2
26
40

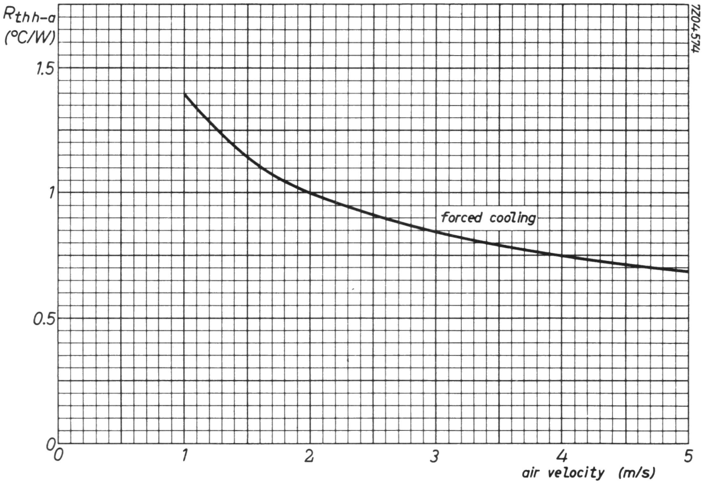

M6
M6
20.1
82
M6
M8
6.5
33.1
31
58
108
7Z04850

The graphs are valid for the combination of diode and heatsink.



Stud: M8
Mounting base, across the flats: 17.0 mm



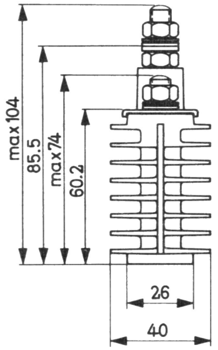


DIECAST HEATSINK

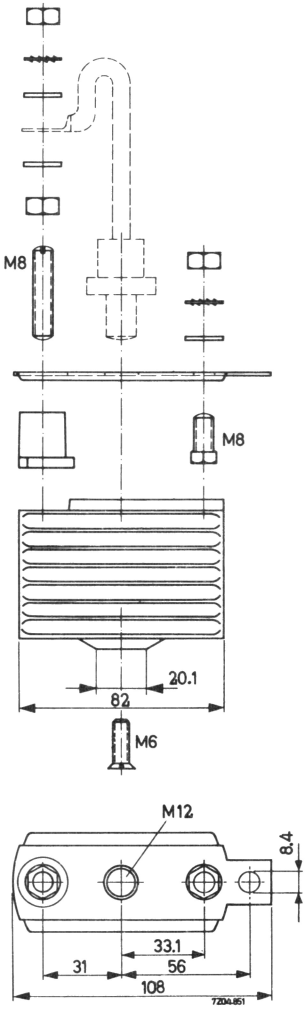
Diecast heatsink of aluminium alloy, painted black, with M12 tap hole for rectifier device.

Dimensions in mm

Weight 295 g

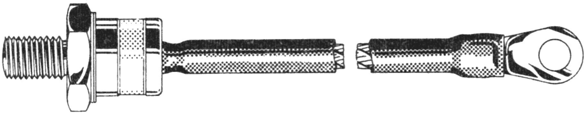


max 104
85.5
max 74
60.2
26
40

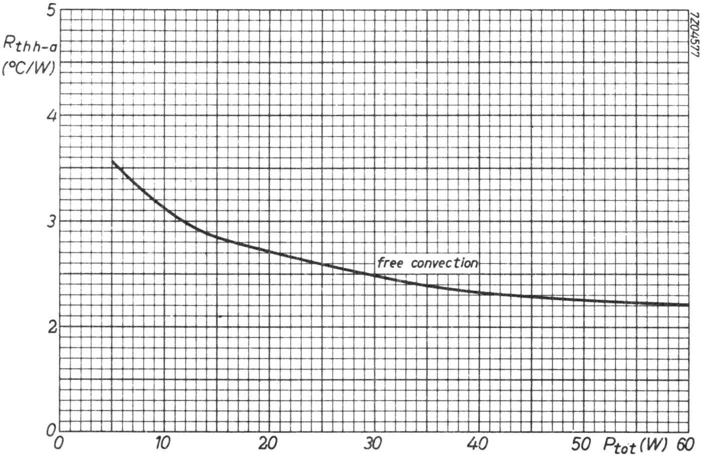


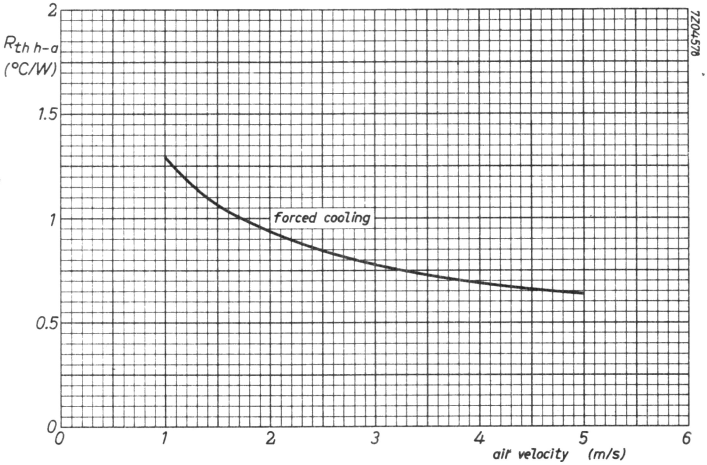
M8
M8
20.1
82
M6
M12
8.4
33.1
31
56
108
7Z04851

The graphs are valid for the combination of diode and heatsink.



Stud: M12
Mounting base, across the flats: 27.0 mm



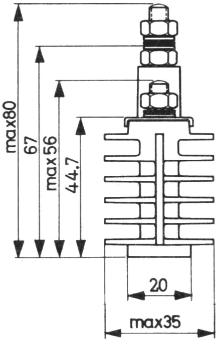


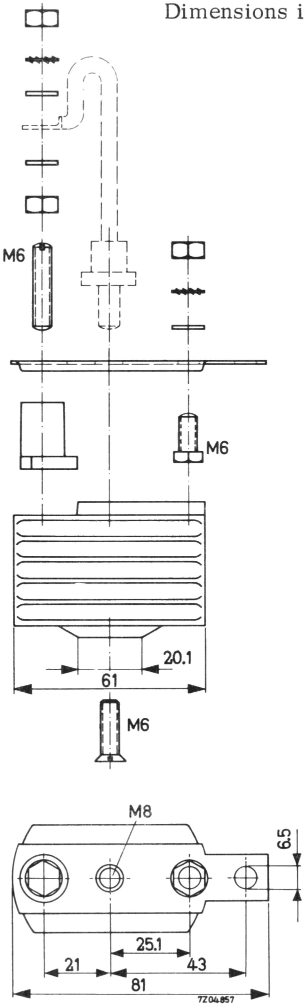
DIECAST HEATSINK

Diecast heatsink of aluminium alloy, painted black, with M8 tap hole for rectifier device.

Dimensions in mm

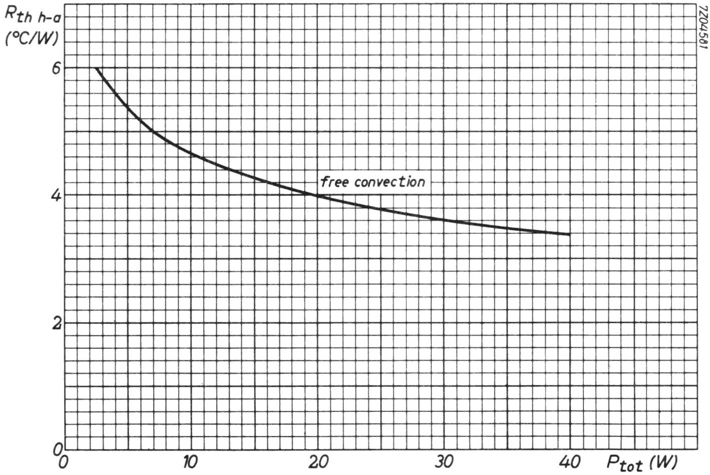
Weight 135 g

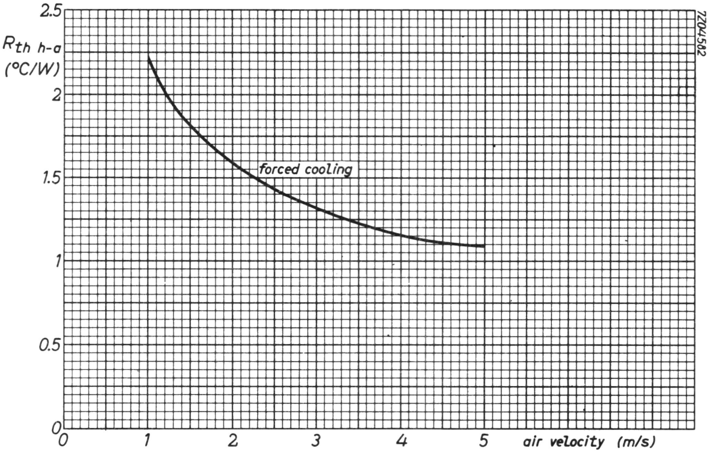

max80
67
max56
44.7
20
max35


M6
M6
20.1
61
M6
M8
6.5
25.1
21
43
81
7Z04857

The graphs are valid for the combination of diode and heatsink.

Stud: M8
Mounting base, across the flats: 17.0 mm



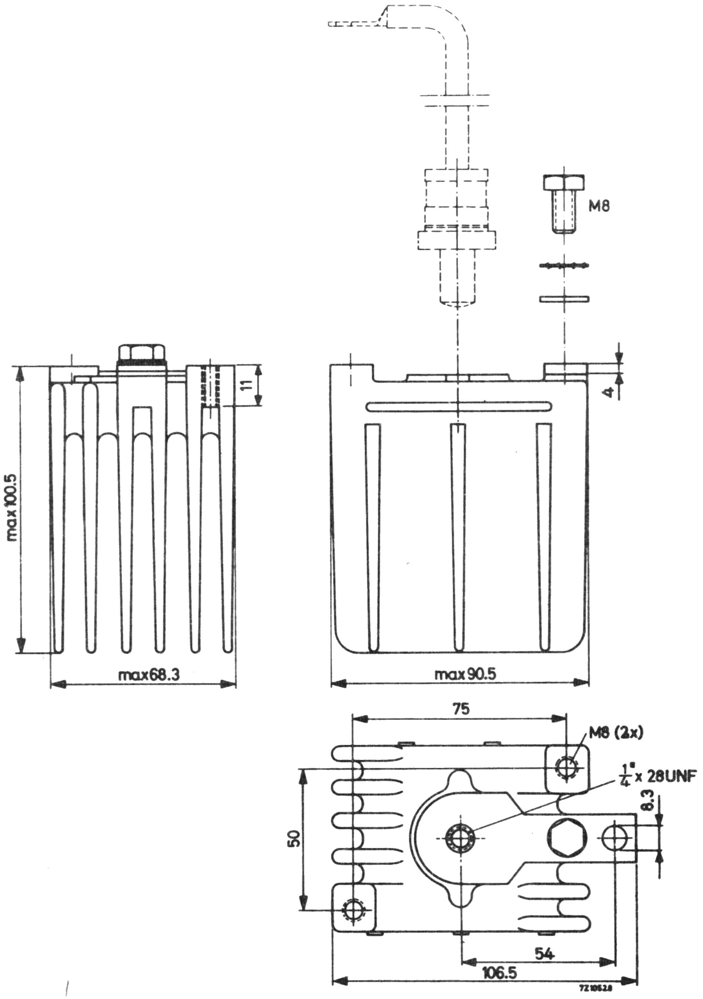


DIECAST HEATSINK

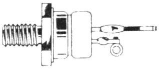
Diecast heatsink of aluminium alloy, painted black, with $\frac{1}{4}$" x28UNF tap hole for rectifier device.

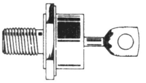
Dimensions in mm

Weight: 690 g


M8
11
4
max100.5
max68.3
max90.5
75
M8 (2x)
$\frac{1}{4}$" x 28UNF
8.3
50
54
106.5
7Z10528

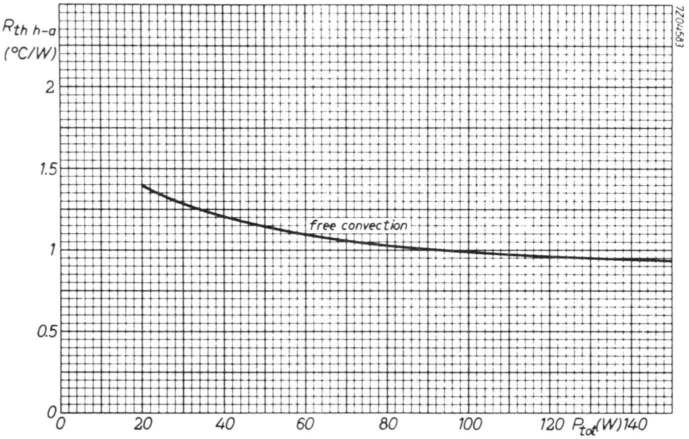
The graphs are valid for the combination of thyristor and heatsink.

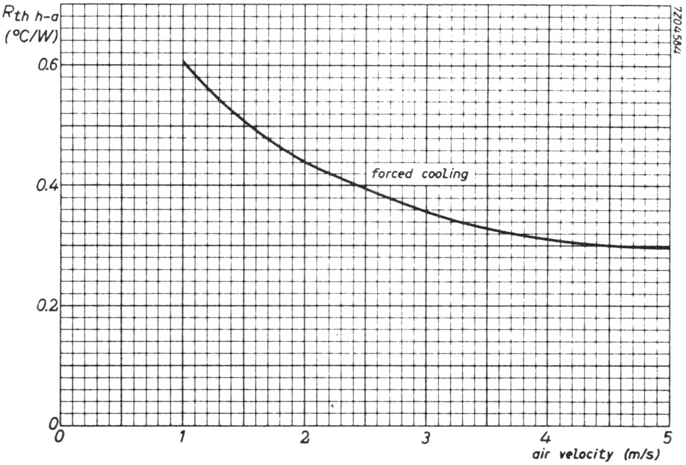




Studs: $\frac{1}{4}$" x 28UNF

Mounting bases across the flats: 14.0 mm resp. 17.0 mm



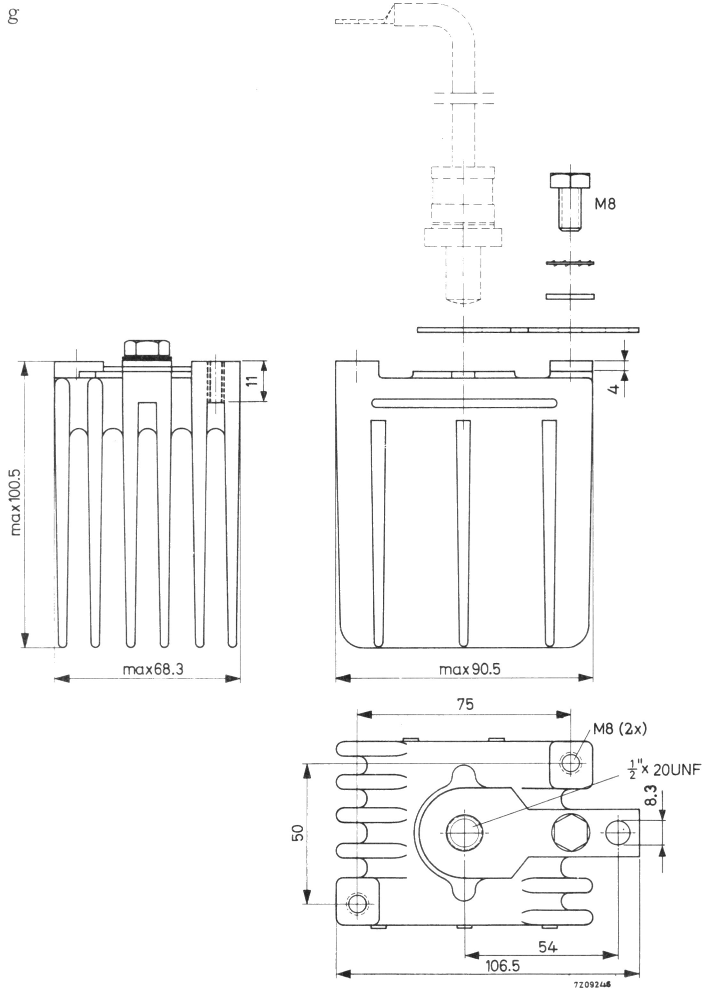


DIECAST HEATSINK

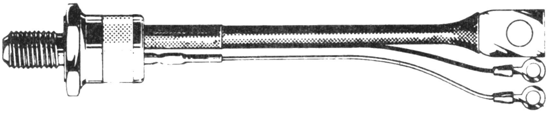
Diecast heatsink of aluminium alloy, painted black, with $\frac{1}{2}''$ x 20UNF tap hole for rectifier device.

Dimensions in mm

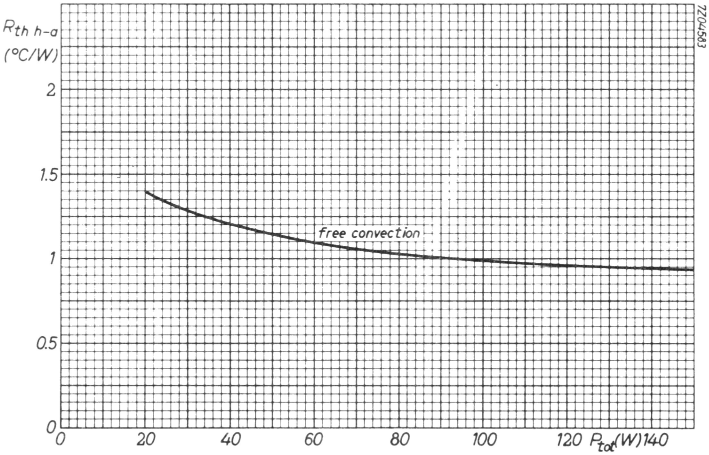
Weight: 690 g

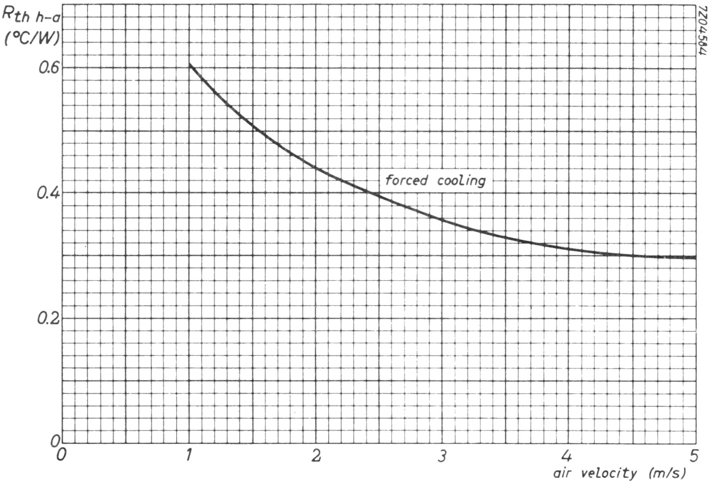

M8
4
11
max100.5
max68.3
max90.5
75
M8 (2x)
½" x 20UNF
8.3
50
54
106.5
7Z09246

The graphs are valid for the combination of thyristor and heatsink.



Stud: $\frac{1}{2}$" x 20UNF
Mounting base, across the flats: 27.0 mm



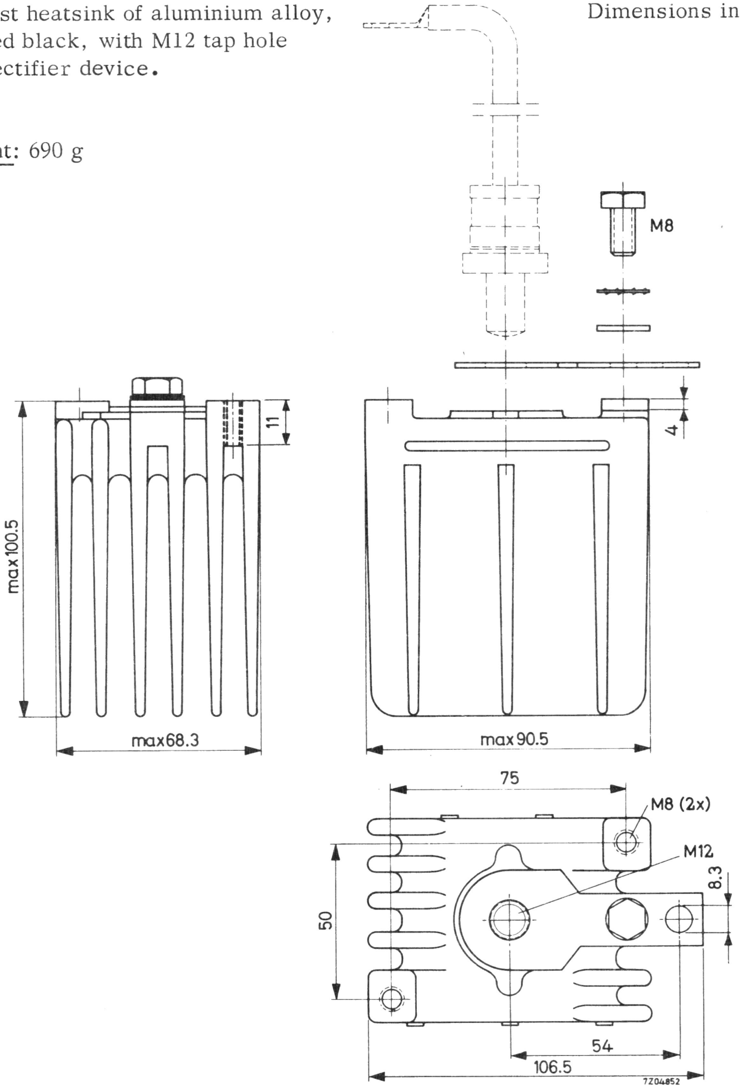


DIECAST HEATSINK

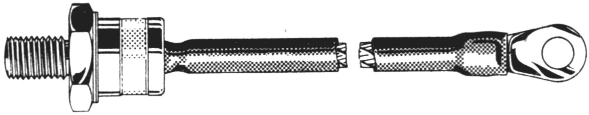
Diecast heatsink of aluminium alloy, painted black, with M12 tap hole for rectifier device.

Dimensions in mm

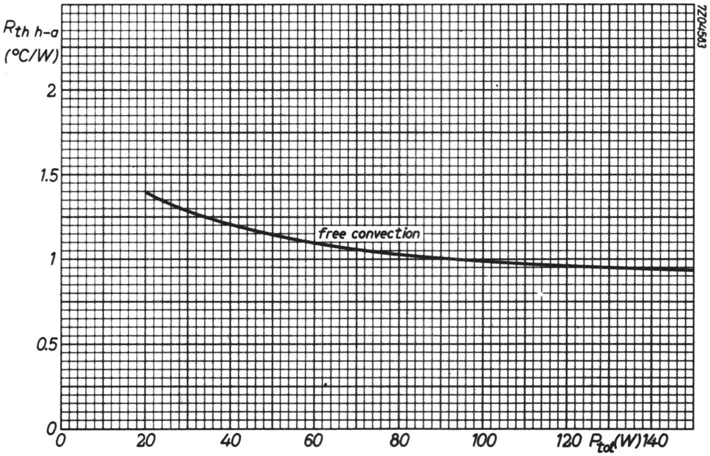
Weight: 690 g

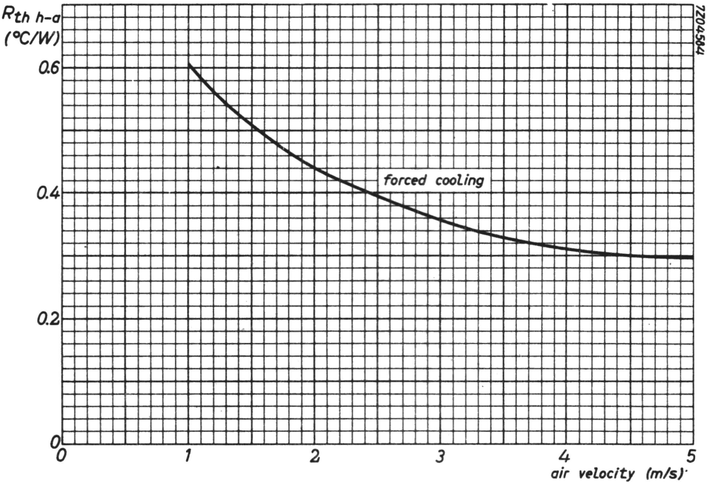

M8
11
4
max100.5
max68.3
max90.5
75
M8 (2x)
M12
8.3
50
54
106.5
7Z04852

The graphs are valid for the combination of device and heatsink.



Stud: M12
Mounting base, across the flats: 27.0 mm



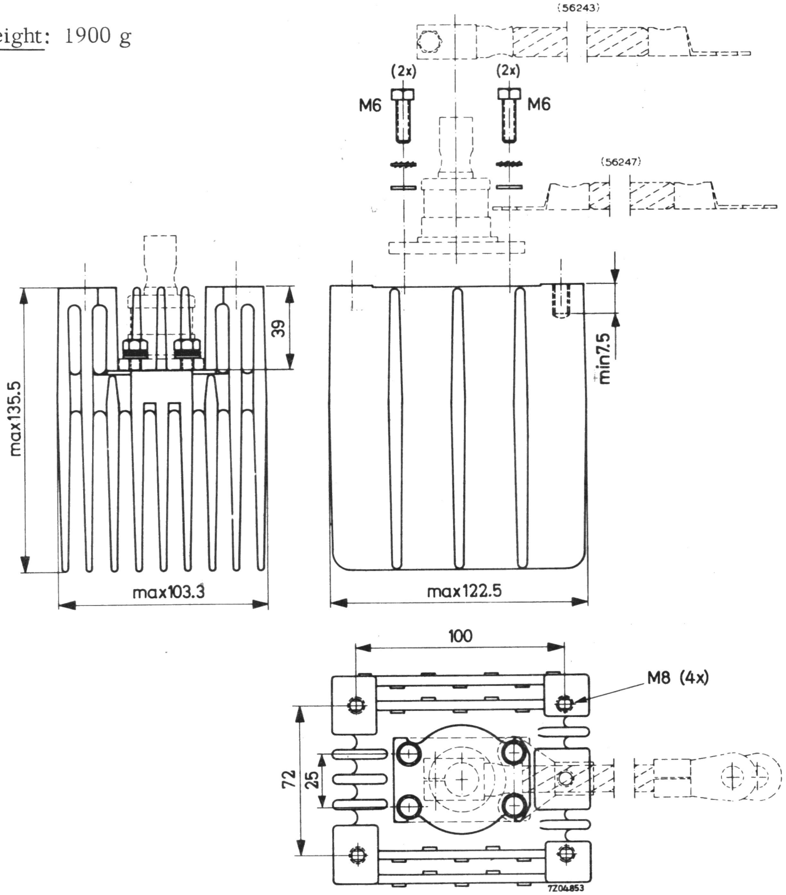


DIECAST HEATSINK

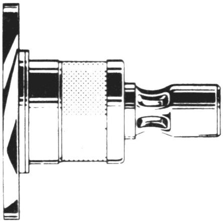
Diecast heatsink of aluminium alloy, painted black, intended for devices with flat mounting base.

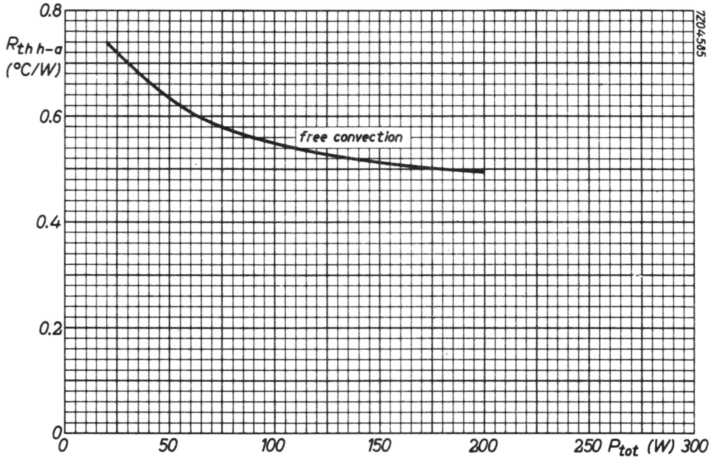
Dimensions in mm

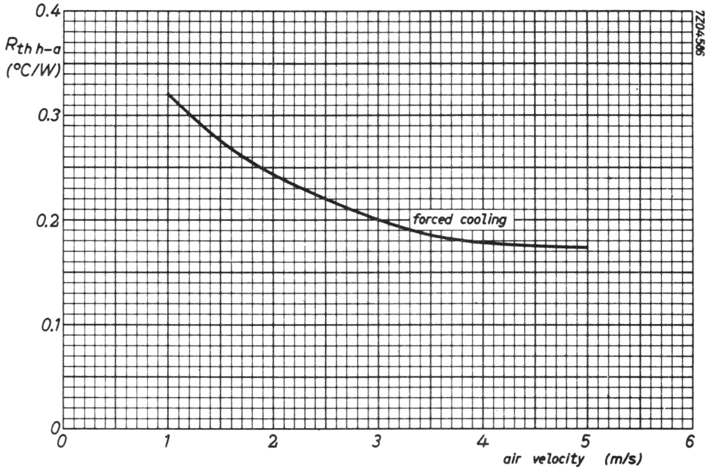
Weight: 1900 g


(56243)
(2x)
M6
(2x)
M6
(56247)
39
min7.5
max135.5
max103.3
max122.5
100
M8 (4x)
72
25
7Z04853

The graphs are valid for the combination of diode and heatsink.





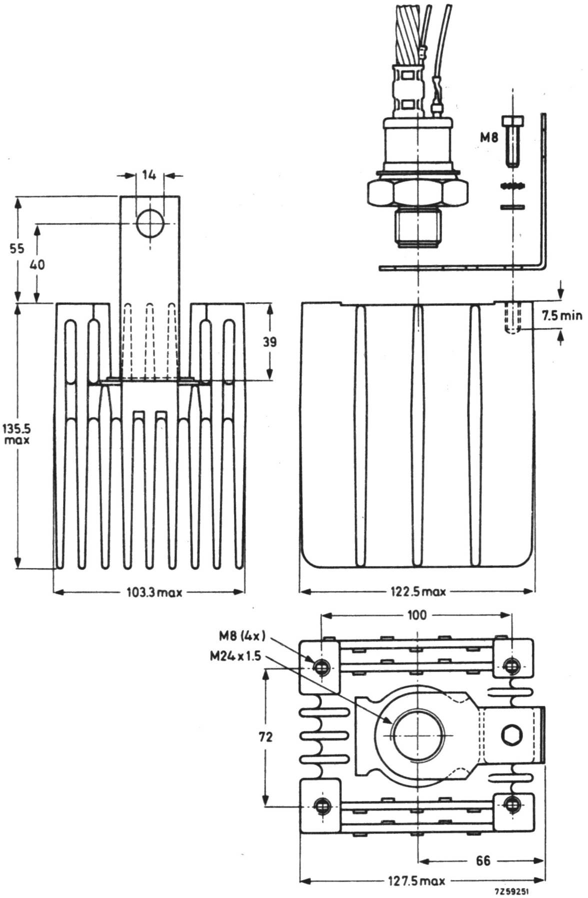


DIECAST HEATSINK

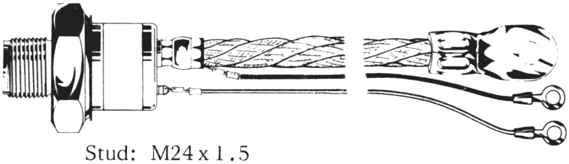
Diecast heatsink of aluminium alloy, painted black, with M24 x 1.5 tap hole for rectifier device.

Dimensions in mm

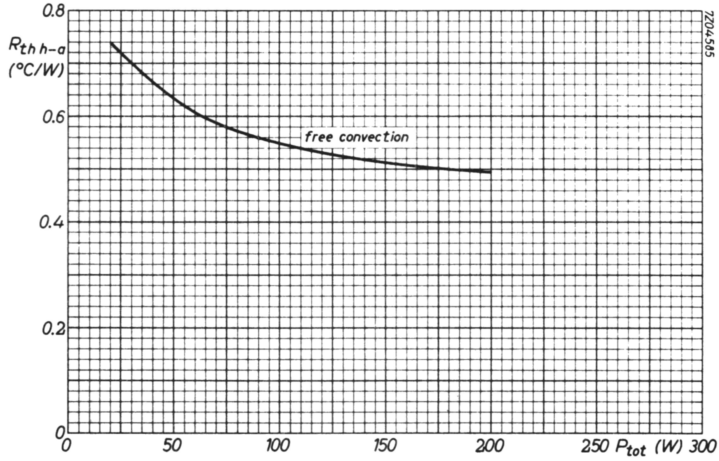
Weight: 1900 g

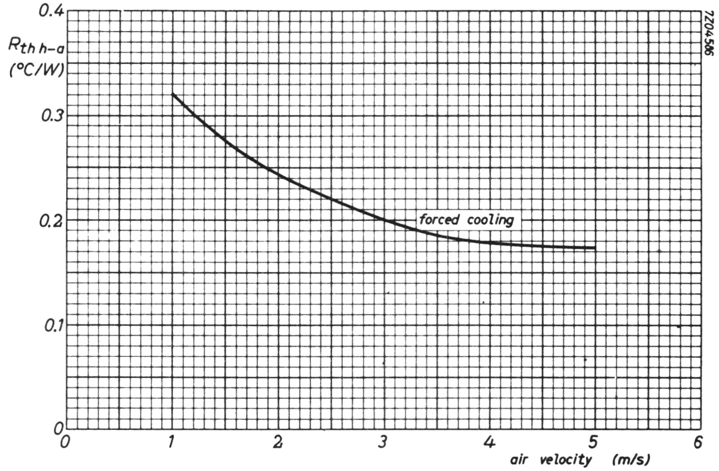

14
55
40
39
135.5 max
103.3 max
M8
7.5 min
122.5 max
100
M8 (4x)
M24 x 1.5
72
66
127.5 max
7Z59251

The graphs are valid for the combination of thyristor and heatsink.



Stud: M24 x 1.5
Mounting base, across the flats: 46 mm



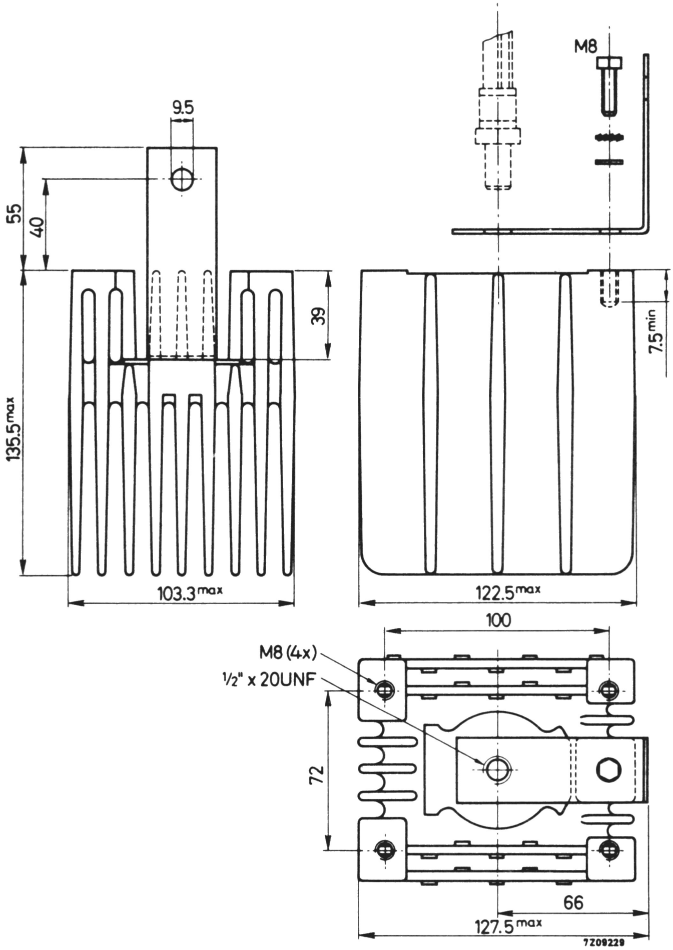


DIECAST HEATSINK

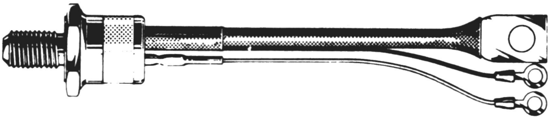
Diecast heatsink of aluminium alloy, painted black, with $\frac{1}{2}''$ x 20UNF tap hole for rectifier device.

Dimensions in mm

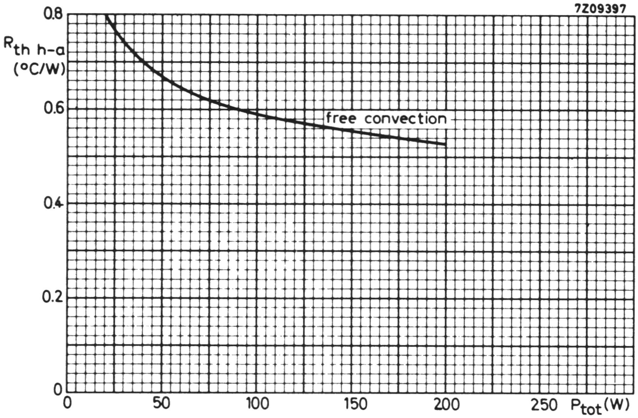
Weight: 1900 g

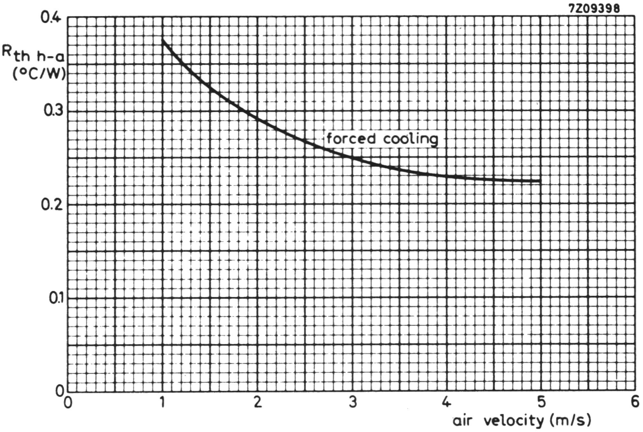

9.5
55
40
39
135.5max
103.3max
M8
7.5min
122.5max
100
M8 (4x)
½" x 20UNF
72
66
127.5 max
7Z09229

The graphs are valid for the combination of thyristor and heatsink.



Stud: $\frac{1}{2}$'' x 20 UNF
Mounting base, across the flats: 27.0 mm



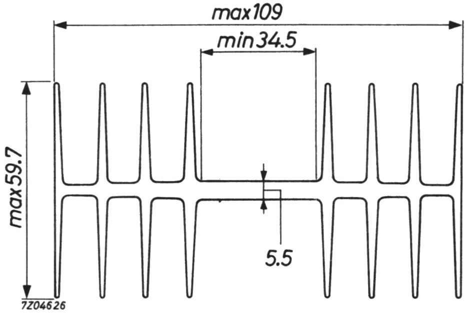


EXTRUDED ALUMINIUM HEATSINK

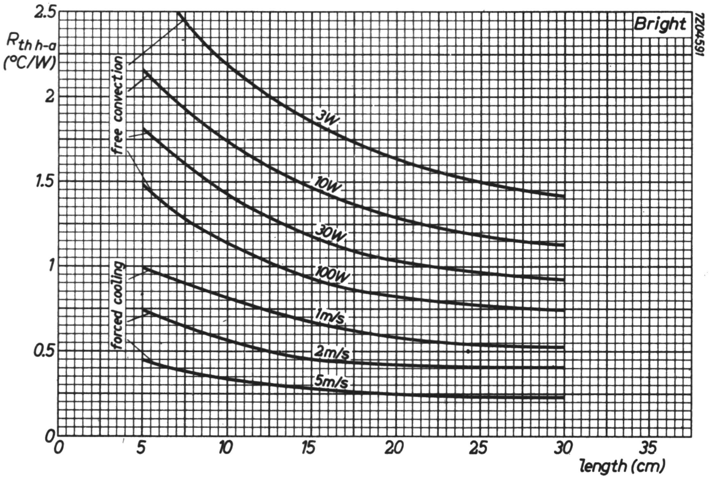
Extruded heatsink of aluminium alloy.
The extrusion is supplied unpainted, in lengths of 1.5 m.

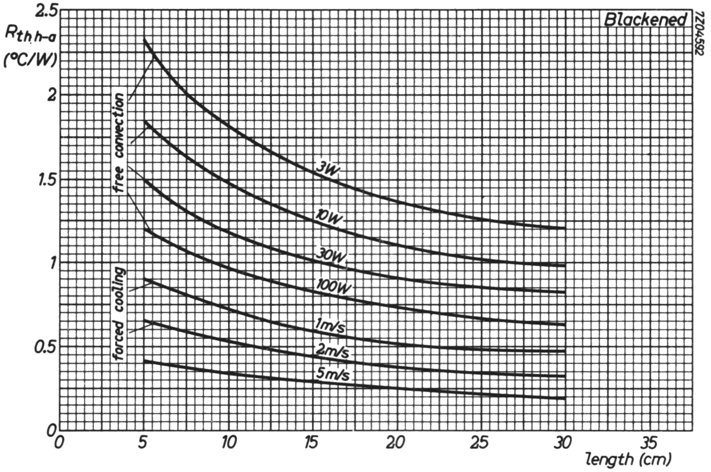
Weight: 4 kg per 1.5 m.

Dimensions in mm


max109
min34.5
max59.7
5.5
7Z04626

The graphs are valid for the combination of rectifier device and heatsink.



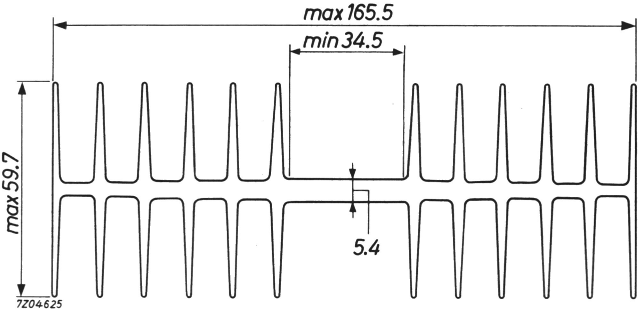


EXTRUDED ALUMINIUM HEATSINK

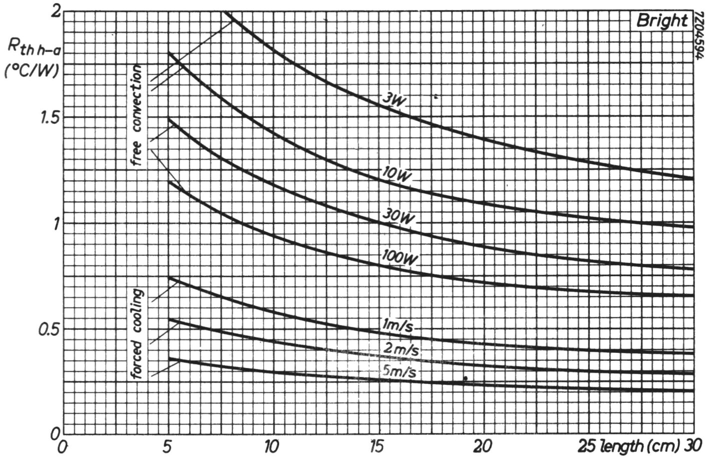
Extruded heatsink of aluminium alloy.
The extrusion is supplied unpainted, in lengths of 1.5 m.

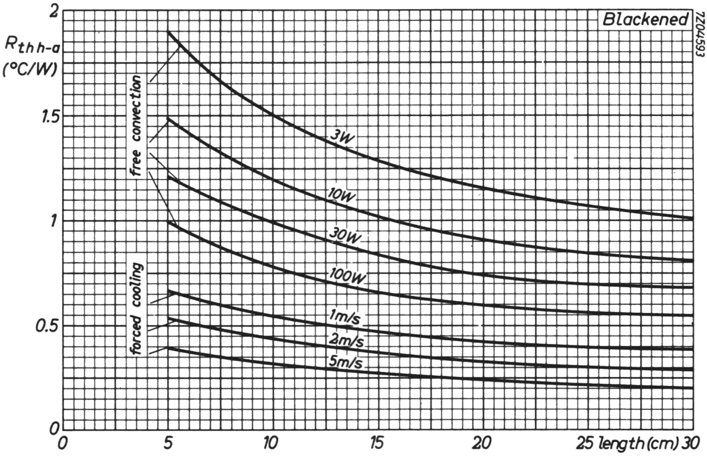
Weight: 6 kg per 1.5 m.

Dimensions in mm


max 165.5
min 34.5
max 59.7
5.4
7Z04625

The graphs are valid for the combination of rectifier device and heatsink.



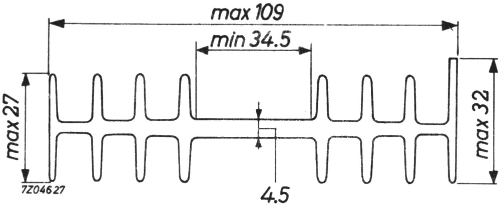


EXTRUDED ALUMINIUM HEATSINK

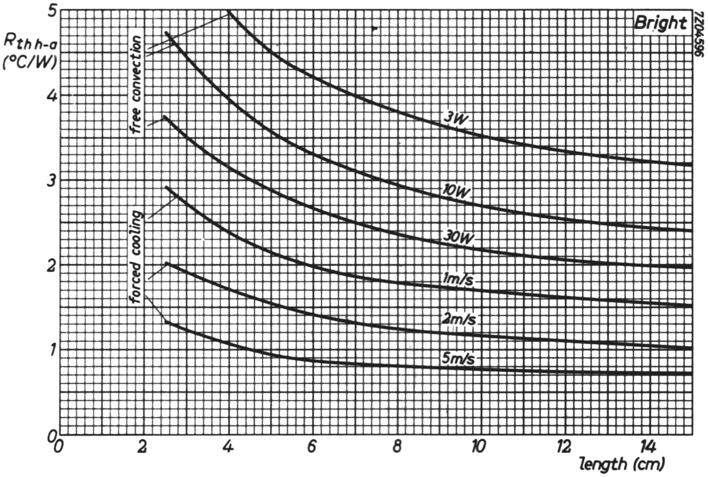
Extruded heatsink of aluminium alloy.
The extrusion is supplied unpainted, in lengths of 1.5 m.

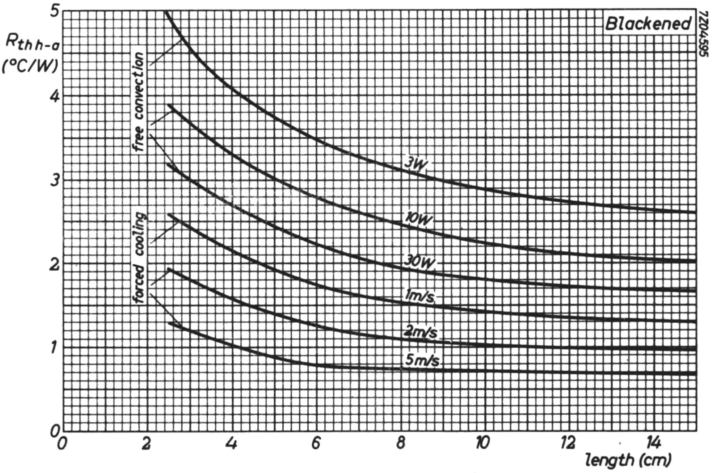
Weight: 2.4 kg per 1.5 m.

Dimensions in mm


max 109
min 34.5
max 27
max 32
4.5
7Z04627

The graphs valid for the combination of rectifier device and heatsinks.



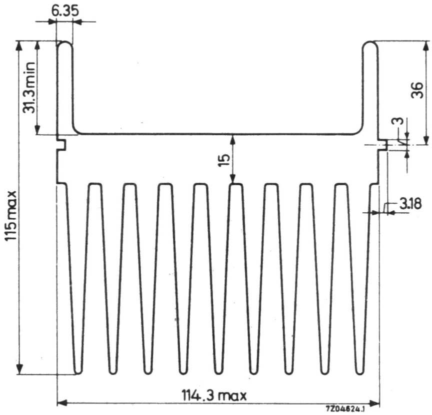


EXTRUDED ALUMINIUM HEATSINK

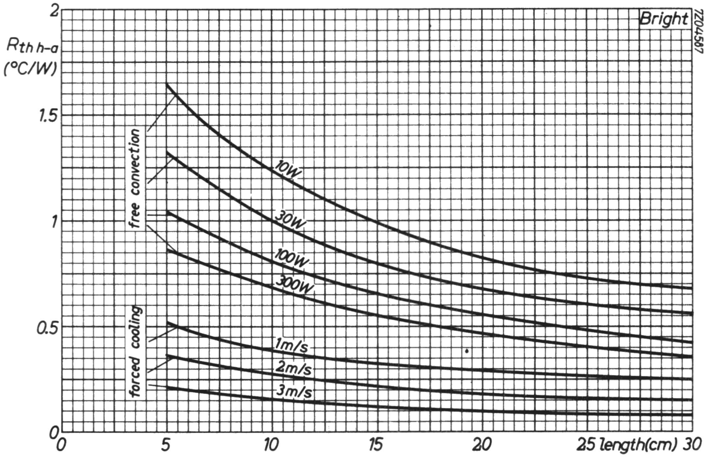
Extruded heatsink of aluminium alloy.
The extrusion is supplied unpainted, in lengths of 1.5 m.

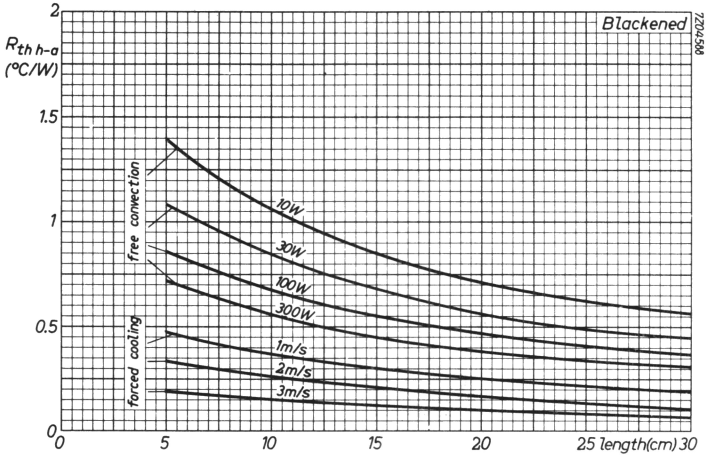
Weight: 16.2 kg per 1.5 m.

Dimensions in mm


6.35
31.3min
36
3
15
3.18
115max
114.3 max
7Z04624.1

The graphs are valid for the combination of rectifier device and heatsink. For devices with a flat base see over.



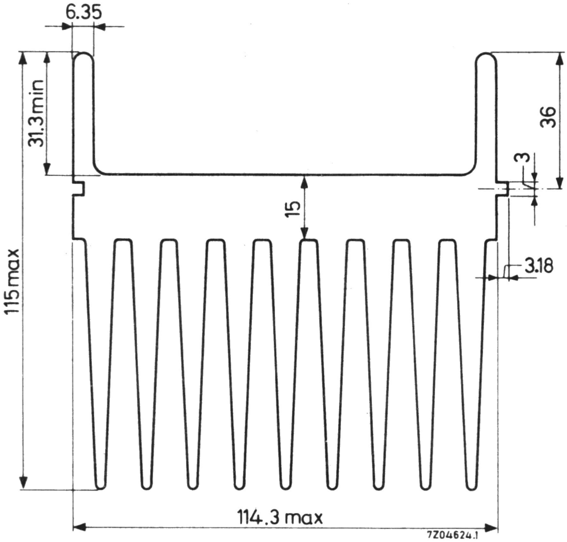


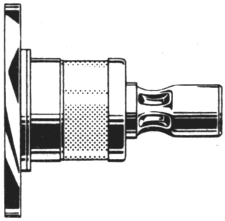
EXTRUDED ALUMINIUM HEATSINK

Extruded heatsink of aluminium alloy.
The extrusion is supplied unpainted, in lengths of 1.5 m.

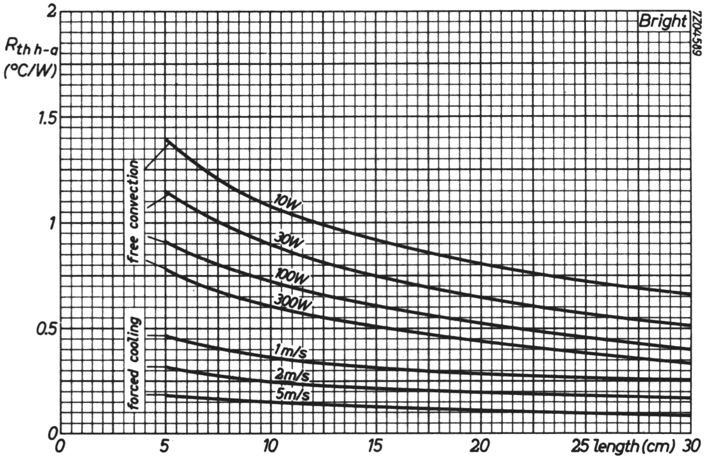
Weight: 16.2 kg per 1.5 m.

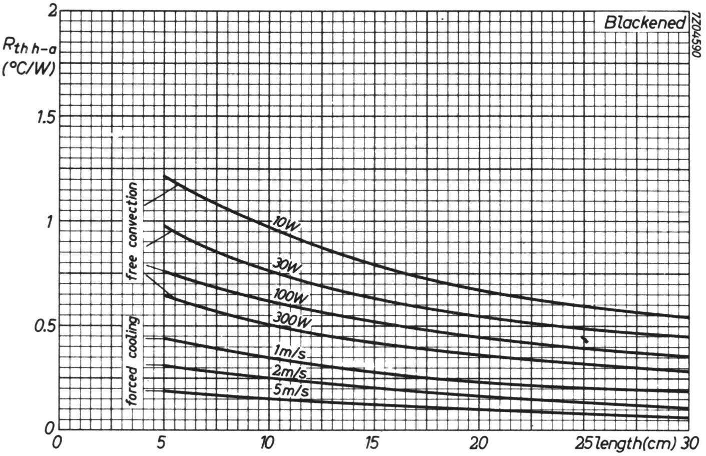
Dimensions in mm


6.35
31.3 min
115 max
15
36
3
3.18
114.3 max
7Z04624.1

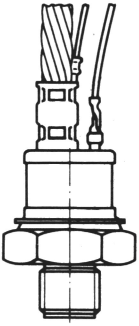


The graphs are valid for the combination of rectifier device and heatsink. For devices with threaded studs turn back one page.



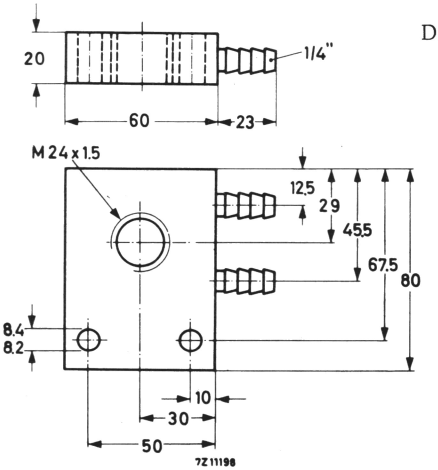


# WATER COOLED HEATSINK
for BTX41series

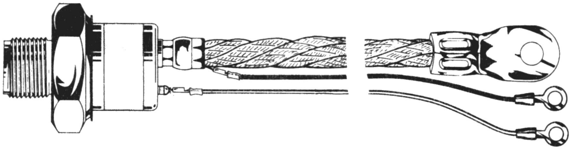


Net weight: 750 g

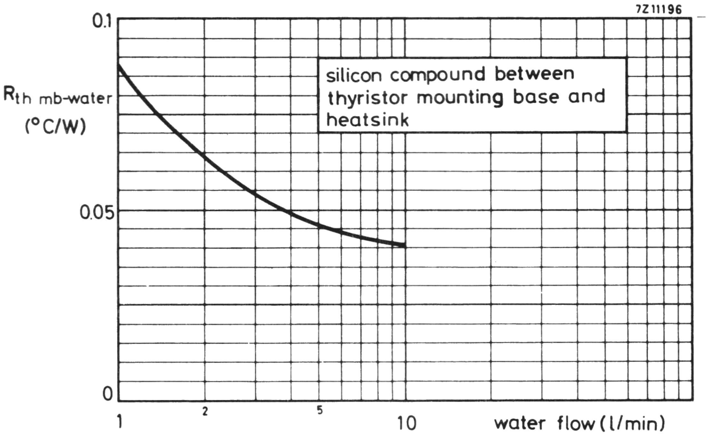
Dimensions in mm

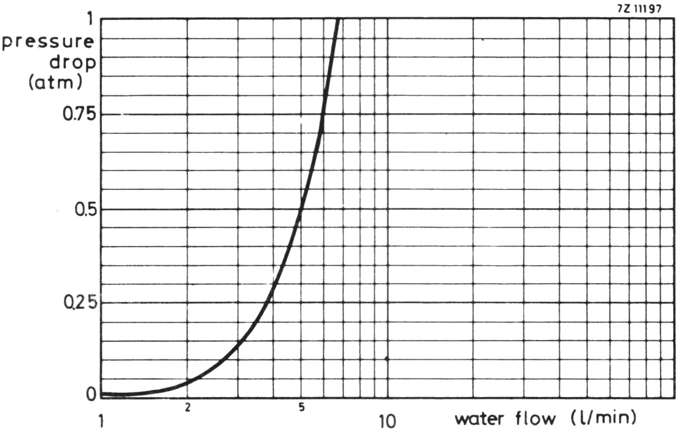

20
1/4"
60
23
M24x1.5
12.5
29
45.5
67.5
80
8.4
8.2
10
30
50
7Z11198

Torque on hexagon: min. 300 kg cm (30 Newton-metres)
max. 400 kg cm (40 Newton-metres)



Stud: M24 x 1.5
Mounting base, across flats: 46 mm





INDEX OF TYPE NUMBERS

The inclusion of a type number in this publication does not necessarily imply its availability.

Type No.	Part	Section	Type No.	Part	Section	Type No.	Part	Section
AA119	1	D	AF116	3	HF	ASZ17	2	P
AAY11	1	D	AF117	3	HF	ASZ18	2	P
AAY21	1	D	AF118	3	HF	ASZ20	3	Sw
AAY30	1	D	AF121	3	HF	ASZ21	3	Sw
AAY32	1	D	AF124	3	HF	AYY10-120	1	R
AAZ13	1	D	AF125	3	HF	BA100	1	D
AAZ15	1	D	AF126	3	HF	BA102	1	Var
AAZ17	1	D	AF127	3	HF	BA114	1	D
AAZ18	1	D	AF139	3	HF	BA145	1	D
AC125	2	LF	AF178	3	HF	BA148	1	D+R
AC126	2	LF	AF239	3	HF	BA182	1	D
AC127	2	LF	AF239S	3	HF	BA216	1	D
AC127/01	2	LF	AF240	3	HF	BA217	1	D
AC128	2	LF	AF267	3	HF	BA218	1	D
AC128/01	2	LF	AFY16	3	HF	BA219	1	D
AC132	2	LF	AFY19	4	Tr	BA220	1	D
AC132/01	2	LF	AFY40	3	HF	BA221	1	D
AC172	2	LF	AFZ12	3	HF	BA222	1	D
AC187	2	LF	ASY26	3	Sw	BAV10	1	D
AC187/01	2	LF	ASY27	3	Sw	BAV40	1	D
AC188	2	LF	ASY28	3	Sw	BAV41	1	D
AC188/01	2	LF	ASY29	3	Sw	BAV42	1	D
AD149	2	P	ASY73	3	Sw	BAV43	1	D
AD161	2	P	ASY74	3	Sw	BAV45	1	D
AD162	2	P	ASY75	3	Sw	BAW56	4	Mm
AEY13	4	Mw	ASY76	3	Sw	BAW62	1	D
AEY15	4	Mw	ASY77	3	Sw	BAX12	1	D
AEY16	4	Mw	ASY80	3	Sw	BAX13	1	D
AF114	3	HF	ASZ15	2	P	BAX15	1	D
AF115	3	HF	ASZ16	2	P	BAX16	1	D

D = Signal diodes
HF = High frequency transistors
LF = Low frequency transistors
Mw = Microwave devices
P = Low frequency power transistors

P = Low frequency power transistors
R = Rectifier diodes
Sw = Switching transistors
Tr = Transmitting transistors
Var = Variable capacitance diodes

Type No.	Part	Section	Type No.	Part	Section	Type No.	Part	Section
BAX17	1	D	BCW29	4	Mm	BCY71	2	LF
BAX18	1	D	BCW30	4	Mm	BCY72	2	LF
BAX78	1	D	BCW31	4	Mm	BCY87	4	Dual
BAY38	1	D	BCW32	4	Mm	BCY88	4	Dual
BAY66	4	Mw	BCW33	4	Mm	BCY89	4	Dual
BAY96	4	Mw	BCW46	2	LF	BCZ10	2	LF
BB104	1	Var	BCW47	2	LF	BCZ11	2	LF
12-BB105	1	Var	BCW48	2	LF	BCZ12	2	LF
12-BB106	1	Var	BCW49	2	LF	BD115	2	P
BB110	1	Var	BCW56	2	LF	BD124	2	P
BB117	1	Var	BCW57	2	LF	BD131	2	P
BC107	2	LF	BCW58	2	LF	BD132	2	P
BC108	2	LF	BCW59	2	LF	BD133	2	P
BC109	2	LF	BCW69	4	Mm	BD135	2	P
BC146	2	LF	BCW70	4	Mm	BD136	2	P
BC147	2	LF	BCW71	4	Mm	BD137	2	P
BC148	2	LF	BCW72	4	Mm	BD138	2	P
BC149	2	LF	BCY10	2	LF	BD139	2	P
BC157	2	LF	BCY11	2	LF	BD140	2	P
BC158	2	LF	BCY12	2	LF	BD181	2	P
BC159	2	LF	BCY30	2	LF	BD182	2	P
BC177	2	LF	BCY31	2	LF	BD183	2	P
BC178	2	LF	BCY32	2	LF	BDY20	2	P
BC179	2	LF	BCY33	2	LF	BDY38	2	P
BC200	2	LF	BCY34	2	LF	BDY60	2	P
BC237	2	LF	BCY38	2	LF	BDY61	2	P
BC238	2	LF	BCY39	2	LF	BDY90	2	P
BC239	2	LF	BCY40	2	LF	BDY91	2	P
BC307	2	LF	BCY54	2	LF	BDY92	2	P
BC308	2	LF	BCY55	4	Dual	BF115	3	HF
BC309	2	LF	BCY56	2	LF	BF167	3	HF
BC327	2	LF	BCY57	2	LF	BF173	3	HF
BC328	2	LF	BCY58	2	LF	BF177	3	HF
BC337	2	LF	BCY59	2	LF	BF178	3	HF
BC338	2	LF	BCY70	2	LF	BF179	3	HF

D = Signal diodes
Dual = Dual transistors
HF = High frequency transistors
LF = Low frequency transistors

Mm = Microminiature devices for thick- and thin-film circuits
Mw = Microwave devices
P = Low frequency power transistors
Var = Variable capacitance diodes

Type No.	Part	Section	Type No.	Part	Section	Type No.	Part	Section
BF179	3	HF	BFS93	3	HF	BLY93A	4	Tr
BF180	3	HF	BFS94	3	HF	BLY94	4	Tr
BF181	3	HF	BFS95	3	HF	BPX25	4	PhDT
BF182	3	HF	BFW10	4	FET	BPX29	4	PhDT
BF183	3	HF	BFW11;12	4	FET	BPX40	4	PhDT
BF184	3	HF	BFW13	4	FET	BPX41	4	PhDT
BF185	3	HF	BFW16A	3	HF	BPX42	4	PhDT
BF194	3	HF	BFW17A	3	HF			
BF195	3	HF	BFW30	3	HF	BPX71	4	PhDT
BF196	3	HF	BFW45	2	Defl			
BF197	3	HF	BFW61	4	FET	BPY10	4	PhDT
BF198	3	HF	BFW92	3	HF	BPY68	4	PhDT
BF199	3	HF	BFX34	3	Sw	BPY69	4	PhDT
BF200	3	HF	BFX44	3	HF	BPY76	4	PhDT
BF254	3	HF	BFX89	3	HF	BPY77	4	PhDT
BF255	3	HF	BFY44	4	Tr	BR100	1	Thyr
BF334	3	HF	BFY50	3	HF	BRY39	1	Thyr
BF335	3	HF	BFY51	3	HF	BRY39(SCS)	3	Sw
BF336	3	HF	BFY52	3	HF	BRY39(PUT)	3	Sw
BF337	3	HF	BFY55	3	HF	BSV52	4	Mm
BF338	3	HF	BFY70	4	Tr	BSV64	3	Sw
BFR29	4	FET	BFY90	3	HF	BSV68	3	Sw
BFR63	3	HF	BLX13	4	Tr	BSV78	4	FET
BFR64	3	HF	BLX14	4	Tr	BSV79	4	FET
BFR65	3	HF	BLX69	4	Tr	BSV80	4	FET
BFS17	4	Mm	BLY14	4	Tr	BSV81	4	FET
BFS18	4	Mm	BLY17	4	Tr	BSV86	3	Sw
BFS19	4	Mm	BLY83	4	Tr	BSV87	3	Sw
BFS20	4	Mm	BLY84	4	Tr	BSV88	3	Sw
BFS21	4	FET	BLY87A	4	Tr	BSV96	3	Sw
BFS21A	4	FET	BLY88A	4	Tr	BSV97	3	Sw
BFS22A	4	Tr	BLY89A	4	Tr	BSV98	3	Sw
BFS23A	4	Tr	BLY90	4	Tr	BSW41	3	Sw
BFS28	4	FET	BLY91A	4	Tr	BSW66	3	Sw
BFS92	3	HF	BLY92A	4	Tr	BSW67	3	Sw

Defl = Deflection transistors
FET = Field effect transistors
HF = High frequency transistors
Mm = Microminiature devices for thick- and thin-film circuits
Sw = Switching transistors
Thyr = Thyristors, diacs, triacs
Tr = Transmitting transistors
PhDT = Photo-diodes and photo-transistors

INDEX

Type No.	Part	Section	Type No.	Part	Section	Type No.	Part	Section
BSW68	3	Sw	BTX94series	1	Thyr	BYX33series	1	R
BSW69	3	Sw	BTX95series	1	Thyr	BYX34series	1	R
BSX12	3	Sw	BTY79series	1	Thyr	BYX35	1	R
BSX12A	3	Sw	BTY87series	1	Thyr	BYX36series	1	R
BSX19	3	Sw	BTY91series	1	Thyr	BYX38series	1	R
BSX20	3	Sw	BTY95series	1	Thyr	BYX39series	1	R
BSX21	3	Sw	BTY99series	1	Thyr	BYX40series	1	R
BSX59	3	Sw	BU105	2	Defl	BYX42series	1	R
BSX60	3	Sw	BU108	2	Defl	BYX45series	1	R
BSX61	3	Sw	BU132	2	Defl	BYX46series	1	R
BSY38	3	Sw	BXY27	4	Mw	BYX48series	1	R
BSY39	3	Sw	BXY28	4	Mw	BYX50series	1	R
BT100Aseries	1	Thyr	BXY29	4	Mw	BYX51series	1	R
BT101series	1	Thyr	BXY32	4	Mw	BYX52series	1	R
BT102series	1	Thyr	BY118	1	R	BYX56series	1	R
BTW23series	1	Thyr	BY122	1	R	BYX59series	1	R
BTW24series	1	Thyr	BY123	1	R	BZX29series	1	Z
BTW30series	1	Thyr	BY126	1	R	BZX48	1	Z
BTW31series	1	Thyr	BY127	1	R	BZX49	1	Z
BTW47series	1	Thyr	BY140	1	R	BZX50	1	Z
BTW92series	1	Thyr	BY164	1	R	BZX61series	1	Z
BTX18series	1	Thyr	BY176	1	R	BZX70series	1	Z
BTX35series	1	Thyr	BY179	1	R	BZX75series	1	Z
BTX36series	1	Thyr	BY184	1	R	BZX79series	1	Z
BTX37series	1	Thyr	BY185	1	R	BZX84series	4	Mm
BTX38series	1	Thyr	BY187	1	R	BZY56	1	Z
BTX41series	1	Thyr	BYX10	1	R	BZY57	1	Z
BTX47series	1	Thyr	BYX13series	1	R	BZY58	1	Z
BTX48series	1	Thyr	BYX22series	1	R	BZY59	1	Z
BTX49series	1	Thyr	BYX23series	1	R	BZY60	1	Z
BTX50series	1	Thyr	BYX25series	1	R	BZY61	1	Z
BTX68series	1	Thyr	BYX27series	1	R	BZY62	1	Z
BTX81series	1	Thyr	BYX29series	1	R	BZY63	1	Z
BTX82series	1	Thyr	BYX30series	1	R	BZY78	1	Z
BTX92series	1	Thyr	BYX32series	1	R	BZY88series	1	Z

Defl = Deflection transistors
Mm = Microminiature devices for thick- and thin-film circuits
Mw = Microwave devices
R = Rectifier diodes
Sw = Switching transistors
Thyr = Thyristors, diacs, triacs
Z = Voltage regulator diodes

Type No.	Part	Section	Type No.	Part	Section	Type No.	Part	Section
BZY91series	1	Z	OA81	1	D	OSB9210	1	St
BZY93series	1	Z	OA85	1	D	OSB9310	1	St
BZY95series	1	Z	OA90	1	D	OSB9410	1	St
BZY96series	1	Z	OA91	1	D	OSM9110	1	St
BZZ14	1	Z	OA92	1	D	OSM9210	1	St
BZZ15	1	Z	OA95	1	D	OSM9310	1	St
BZZ16	1	Z	OA200	1	D	OSM9410	1	St
BZZ17	1	Z	OA202	1	D	OSS9110	1	St
BZZ18	1	Z	OAP12	4	PhDT	OSS9210	1	St
BZZ19	1	Z	OAZ200	1	Z	OSS9310	1	St
BZZ20	1	Z	OAZ201	1	Z	OSS9410	1	St
BZZ21	1	Z	OAZ202	1	Z	RPY13	4	PhC
BZZ22	1	Z	OAZ203	1	Z	RPY18	4	PhC
BZZ23	1	Z	OAZ204	1	Z	RPY19	4	PhC
BZZ24	1	Z	OAZ205	1	Z	RPY20	4	PhC
BZZ25	1	Z	OAZ206	1	Z	RPY27	4	PhC
BZZ26	1	Z	OAZ207	1	Z	RPY33	4	PhC
BZZ27	1	Z	OC122	3	Sw	RPY41	4	PhC
BZZ28	1	Z	OC123	3	Sw	RPY43	4	PhC
BZZ29	1	Z	OC139	3	Sw	RPY55	4	PhC
CAY10	4	Mw	OC140	3	Sw	RPY58	4	PhC
CQY11B	4	L	OC141	3	Sw	RPY71	4	PhC
CXY10	4	Mw	OCP70	4	PhDT	RPY76A	4	I
CXY11A	4	Mw	ORP10	4	I	1N748A	1	Z
CXY11B	4	Mw	ORP13	4	I	1N749A	1	Z
CXY11C	4	Mw	ORP30N	4	PhC	1N750A	1	Z
CXY12	4	Mw	ORP50	4	PhC	1N751A	1	Z
OA5	1	D	ORP52	4	PhC	1N752A	1	Z
OA7	1	D	ORP60	4	PhC	1N753A	1	Z
OA9	1	D	ORP61	4	PhC	1N754A	1	Z
OA47	1	D	ORP62	4	PhC	1N755A	1	Z
OA70	1	D	ORP63	4	PhC	1N756A	1	Z
OA72	1	D	ORP69	4	PhC	1N757A	1	Z
OA73	1	D	ORP90	4	PhC	1N758A	1	Z
OA79	1	D	OSB9110	1	St	1N759A	1	Z

D = Signal diodes
I = Infrared devices
L = Light emitting diodes, etc.
Mw = Microwave devices

PhC = Photoconductive devices
PhDT = Photo-diodes and photo-transistors
St = Rectifier stacks
Sw = Switching tansistors
Z = Voltage regulator diodes

Type No.	Part	Section
1N914	1	D
1N914A	1	D
1N914B	1	D
1N916	1	D
1N916A	1	D
1N916B	1	D
1N4009	1	D
1N4148	1	D
1N4150	1	D
1N4151	1	D
1N4154	1	D
1N4446	1	D
1N4448	1	D
1N5152	4	Mw
1N5153	4	Mw
1N5155	4	Mw
1N5157	4	Mw
1N5729B	1	Z
1N5730B	1	Z
1N5731B	1	Z
1N5732B	1	Z
1N5733B	1	Z
1N5734B	1	Z
1N5735B	1	Z
1N5736B	1	Z
1N5737B	1	Z
1N5738B	1	Z
1N5739B	1	Z
1N5740B	1	Z
1N5741B	1	Z
1N5742B	1	Z
1N5743B	1	Z
1N5744B	1	Z
1N5745B	1	Z
1N5746B	1	Z
1N5747B	1	Z
1N5748B	1	Z
1N5749B	1	Z
1N5750B	1	Z
1N5751B	1	Z
1N5752B	1	Z
1N5753B	1	Z
1N5754B	1	Z
1N5755B	1	Z
1N5756B	1	Z
1N5757B	1	Z
2N706A	3	Sw
2N708	3	Sw
2N743	3	Sw
2N744	3	Sw
2N753	3	Sw
2N914	3	Sw
2N929	2	LF
2N930	2	LF
2N1131	3	Sw
2N1132	3	Sw
2N1302	3	Sw
2N1303	3	Sw
2N1304	3	Sw
2N1305	3	Sw
2N1306	3	Sw
2N1307	3	Sw
2N1308	3	Sw
2N1309	3	Sw
2N1613	3	HF
2N1711	3	HF
2N1893	3	HF
2N2218	3	Sw
2N2218A	3	Sw
2N2219	3	Sw
2N2219A	3	Sw
2N2221	3	Sw
2N2221A	3	Sw
2N2222	3	Sw
2N2222A	3	Sw
2N2297	3	HF
2N2368	3	Sw
2N2369	3	Sw
2N2369A	3	Sw
2N2483	3	HF
2N2484	3	HF
2N2894	3	Sw
2N2894A	3	Sw
2N2904	3	Sw
2N2904A	3	Sw
2N2905	3	Sw
2N2905A	3	Sw
2N2906	3	Sw
2N2906A	3	Sw
2N2907	3	Sw
2N2907A	3	Sw
2N3055	2	P
2N3133	3	Sw
2N3134	3	Sw
2N3303	3	Sw
2N3375	4	Tr
2N3426	3	Sw
2N3442	2	P
2N3553	4	Tr
2N3570	3	HF
2N3571	3	HF
2N3572	3	HF
2N3632	4	Tr
2N3823	4	FET
2N3866	4	Tr

D = Signal diodes
HF = High frequency diodes
LF = Low frequency diodes
Mw = Microwave devices
P = Low frequency power transistors
Sw = Switching transistors
Tr = Transmitting transistors
Z = Voltage regulator diodes

Type No.	Part	Section	Type No.	Part	Section	Type No.	Part	Section
2N3924	4	Tr	56201d	2.3.4	A	56268	1	DH
2N3926	4	Tr	56201e	2.3.4	A	56271	1	DH
2N3927	4	Tr	56203	2.3.4	A	56274	1	DH
2N3966	4	FET	56207	2.3.4	A	56277	1	DH
2N4036	3	Sw	56208	2.3.4	A	56278	1	DH
2N4091	4	FET	56209	2.3.4	A	56279	1	DH
2N4092	4	FET	56210	2.3.4	A	56280	1	DH
2N4093	4	FET	56213	2.3.4	A	56283	1	DH
2N4347	2	P	56218	2.3.4	A	56284	1	DH
2N4391	4	FET	56226	2.3.4	A	56286	1	DH
2N4392	4	FET	56227	2.3.4	A	56290	1	HE
2N4393	4	FET	56230	1	HE	56293	1	HE
2N4427	4	Tr	56231	1	HE	56295	1	A
2N4856	4	FET	56233	1	A	56296	1	A
2N4857	4	FET	56234	1	A	56299	1	A
2N4858	4	FET	56239	2.3.4	A	56302	2.3.4	A
2N4859	4	FET	56243	1	A	56303	2.3.4	A
2N4860	4	FET	56243A	1	A	56309B	1	A
2N4861	4	FET	56244	1	A	56309R	1	A
61SV	4	I	56245	2.3.4	A	56311	1	WH
40809	2	LF	56246	1 to 4	A			
40819	2	LF	56247	1	A			
40820	3	HF	56250	1	DH			
40822	3	HF	56253	1	DH			
40829	3	HF	56256	1	DH			
56200	2.3.4	A	56261	2.3.4	A			
56201	2.3.4	A	56262A	1	A			
56201a	2.3.4	A	56263	1 to 4	A			
56201b	2.3.4	A	56264A	1	A			
56201c	2.3.4	A	56265	2.3.4	A			

A = Accessories
DH = Diecast heatsinks
FET = Field effect transistors
HE = Heatsink extrusions
HF = High frequency transistors
I = Infrared devices

LF = Low frequency transistors
P = Low frequency power transistors
Sw = Switching transistors
Tr = Transmitting transistors
WH = Water cooled heatsinks

General

Signal diodes

Variable capacitance diodes

Voltage regulator diodes

Rectifier diodes

Thyristors, diacs, triacs

Rectifier stacks

Accessories

Heatsinks

Printed in The Netherlands

9399 251 17901